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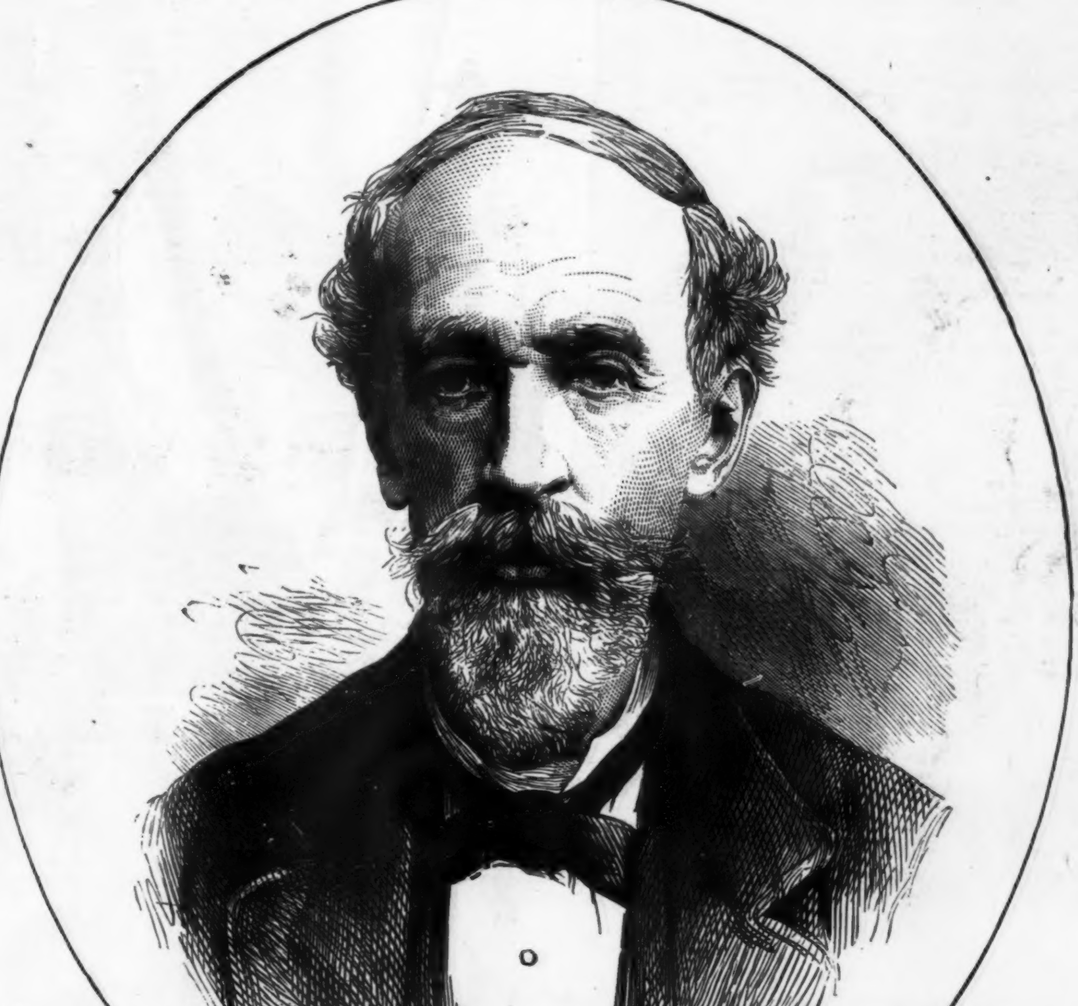
JOHN PENN.

THIS eminent mechanical engineer, well known as the inventor and constructor of the most approved steam engines for ships and steamboats, was born in 1805, at Greenwich, where his father had established a factory for making agricultural implements and other machines. He began work very early, and fitted the steamers Ipswich and Suffolk, running to London along the east coast, with beam engines, each of 40-horse power. In 1835 four passenger boats to run between Greenwich and London were similarly engined by him. In 1838 his well-known oscillating engines with tubular boilers were applied to some of the boats running



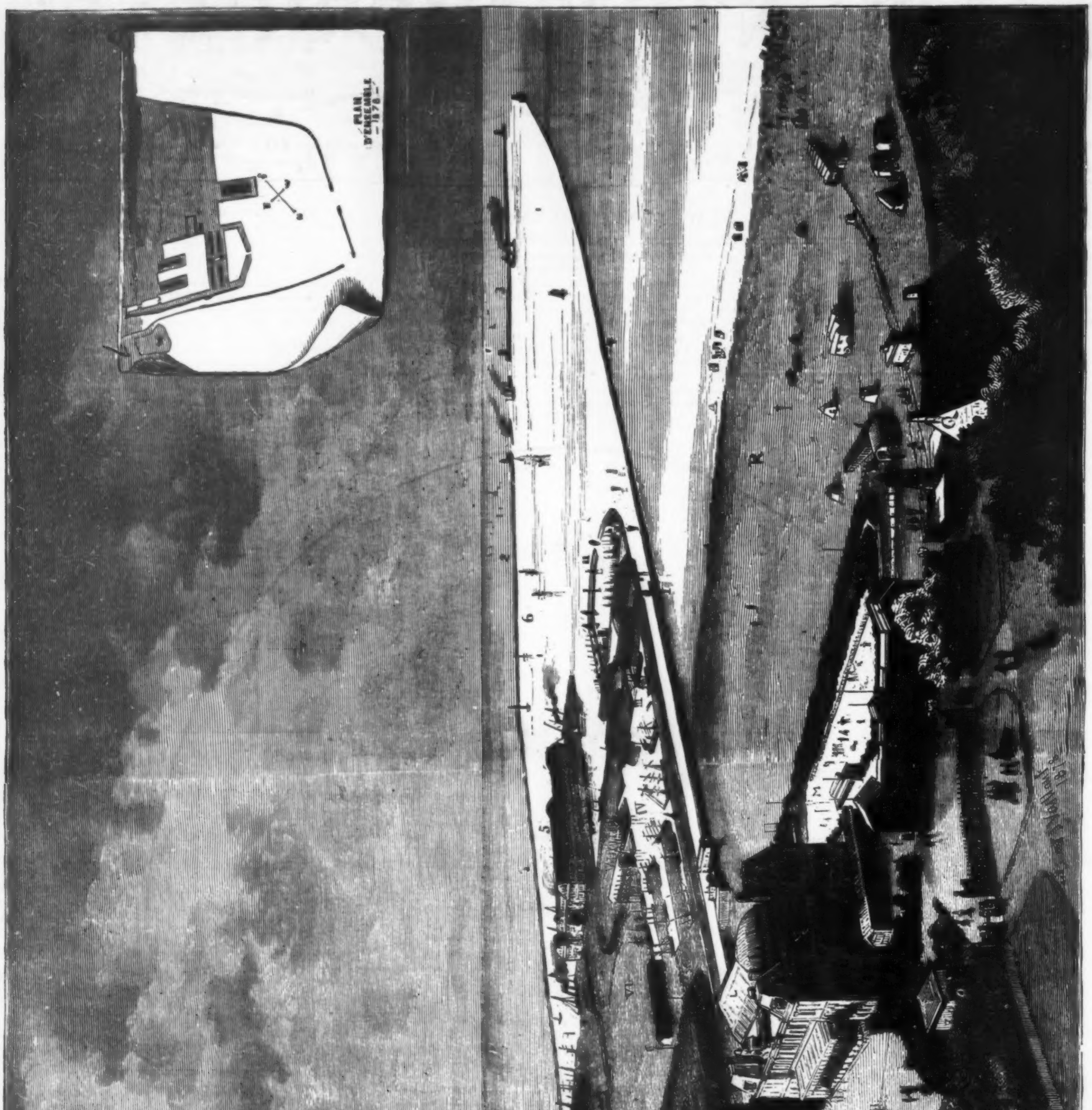
JOHN PENN.

above London Bridge. The way in which these worked attracted general attention. In 1844 the Lords of the Admiralty were induced to place their yacht, the Black Eagle, in his hands. He replaced her former engines by oscillators of double the power, with tubular flue boilers, but in the same space and without any increase of weight. A number of orders followed to fit up ships on the same principle. Among them we may mention her Majesty's yacht the Victoria and Albert and the Great Britain. But Mr. Penn's success was still more remarkable with the trunk engine, designed for the propulsion of fighting ships by the screw, and capable of being placed so far below the water line as to be safe from an enemy's shot. In 1847 he was commissioned to fit her Majesty's ships Arrogant and Encounter on this system. He has applied trunk engines in no less than 230 vessels, varying in power from the small gunboat of 20-horse power to such ships as the Sultan, giving an indicated power of 8,629 horses, and the Neptune (late Independencia), giving upward of 8,800 indicated horse power. These, we believe, are the largest amounts of power hitherto realized with one pair of engines since the use of steam for marine propulsion began. Up to the present time he and his firm have fitted 735 vessels with engines, having an aggregate actual power of more than 500,000 horses. A list of the ships in which this amount of machine force has been distributed would include the Orlando, Howe, Bellerophon, Inconstant, Northampton, Ajax, Agamemnon, Hercules, Sultan, Warrior, Black Prince, Achilles, Minotaur, and Northumberland. In 1854, at the commencement of the Crimean War, when Admiral Napier found himself powerless in the Baltic for want of gunboats, it became imperative to have 120 of them, with 60-horse engines on board, ready for next spring, and at first the means for turning out so large an amount of work in so short a time puzzled the Admiralty. Mr. Penn pointed out, and put in practice, an easy solution of the mechanical difficulty. By calling to his assistance the best workshops in the country, in duplicating parts, and by a full use of the resources of his own establishments at Greenwich and Deptford, he was able to fit up with the requisite engine power ninety-seven gunboats. Altogether during the Crimean War 121 vessels were fitted with engines for our Government by Mr. Penn. He has taken out numerous patents for improvements in steam engines, and one of these, now in universal use, aptly illustrates his fertility of resource as a mechanician. In the early days of screw propulsion no bearings of brass or other metal could be got to stand the strain of the stern shaft, and at one moment it seemed as if the screw must be abandoned and the paddle-wheel reverted to. Mr. Penn solved the problem by using "lignum vitæ" wood bearings, which, lubricated by water, were found to act without any appreciable wear.

Mr. Penn was elected a member of the Institution of Civil Engineers in 1828 and a Fellow of the Royal Society in 1859. He was formerly President of the Society of Mechanical Engineers, and he received many marks of distinction from foreign governments. He married, in 1847, Ellen, daughter of Mr. William English, of Enfield, and has left four sons and two daughters. In 1872 he took his two eldest sons into partnership, and they are now the heads of the firm, which employs upward of 2,000 hands. Mr. Penn himself retired from business in 1875.

The funeral of Mr. Penn, which took place September 28th, 1878, in St. Margaret's Churchyard, Belmont Hill, Lee, adjacent to his residence, "The Cedars," was attended by a thousand of the workmen employed by Messrs. John Penn & Sons, and by about a hundred gentlemen, among whom were several engineers of repute and many personal friends. The portrait is from a photograph.—*Illustrated London News.*

A NEW mitrailleuse is being constructed in Switzerland for the Russian Government, and is said to be extremely efficacious. It has been shown by experiments that the larger size throw from 160 to 300 projectiles per minute, and the smaller from 800 to 1,400. The penetration obtained has been three ¾-inch iron plates. The Swedish Government has taken one of these weapons on trial. They are said to have the great advantage of being extremely light—the smaller sizes can be carried by men and the larger by horses.



THE NEW HARBOR AT BOULOGNE, FRANCE, AS IT WILL BE—BIRD'S-EYE VIEW FROM THE EAST CLIFF.

THE NEW HARBOR AT BOULOGNE.

THE Government of the French Republic has begun the construction of a deep and capacious harbor at Boulogne-sur-Mer, to be formed by sea walls inclosing a large space, which will comprise 340 acres of good anchorage outside the present shore line, so as to advance the steamboat wharf to a new basin that will have, when dredged, a depth of five meters, or nearly sixteen and a half feet, at low tide. The railway trains will run out to this wharf; and the surrounding harbor, beyond it, will be protected by long jetties and breakwaters on three sides, these sea walls having an aggregate length of one mile and a half. There is to be a passage, between two jetties, to enter the inner harbor of the town. It is further proposed to form docks in part of the space reclaimed by the sea wall, and a small harbor for the Boulogne fishing boats. Vessels drawing 26 feet water will enter the harbor at lowest tide. The ceremony of laying the foundation stone of a monument to commemorate the beginning of this great and useful work was performed on September 2d, 1878.

We give a general panorama of the works, drawn after the plans exhibited in the Paris Exhibition by the Boulogne Chamber of Commerce. On ascending the steep zigzaggy lane which from the Boulevard Ste. Beuve leads to the Fishermen's Calvary, on the East Cliff, and entering the inclosure of this newly-reconstructed road, an extensive sea prospect lies before the spectator. In the southwest the horizon is bounded by the bluff headland, Cape Alpreck (A), and its outer defense, Fort de l'Heurt (B). The next point bears the signaling station (C) on Mont de Couppes; betwixt lies in shelter the quaint fishing village, Le Portel. In D stand the butts, where rifle practice takes place; and at the foot of the bold cliffs, and over their eastern slope, is seen Châtillon (E), partly intercepted by the Port Battery (F), which is bounded in its rear by the Creek (G), where boat-building and repairing are carried on; and on the eastern face by the beginning of the West Jetty, whose head (H) is shown by the Tide Signal Tower; while in I stands the Northeast Pier Head, with its port lighthouse; and in K one of the Humane Society's lifeboats. Between the two piers is the present port channel. The large and handsome building (L) which stands in the middle of gardens (N) close to a skating rink (M), artificial rocks (O) which contain an aquarium, and the harbormaster's office (P), is the well-known Etablissement des Bains, which justly ranks second to none of the seaside casinos abroad; in front of it extends the splendid, smooth, level sand beach (R), which makes Boulogne almost unrivaled as a bathing station. The Humane Society's Receiving House (Q) shows its roof in the nearest foreground on the right.

All these parts, designated by letters, portray things as they now are. Those marked in ordinary figures record in a bird's-eye view those portions of the intended new harbor works. These works comprise (1) a southwest stone pier, running for 1,472 yards in a straight line from a point at the foot of the cliffs, half-way between the rifle butts (D) and the semaphore station (C); then, by means of a curved portion 218 yards in length, it joins (2) the deep-sea breakwater 654 yards long. North of this is a passage 272 yards wide, with a minimum depth of nearly twenty-six feet of water at low spring tides; 3 is a stone mole 544 yards in length, affording a second entrance, 163 yards wide, to (6) the anchorage and harbor of refuge, which will cover an area of 137 hectares (340 acres); 4 shows an extension (1,570 yards long) of the present northeast timber jetty. The international passenger and goods traffic is provided for by the erection, upon (5) the Steam-packet Pier, of an extensive railway station, to and from which trains will run in direct connection with the Paris, Brussels, and Calais lines, while general commercial purposes will be served by the ample accommodations given by (7) quays 672 yards long, and by warehouses to be built upon (8) the ground recovered from the sea. In addition to the above-described works, which constitute the Deep-sea Harbor of Boulogne, according to the plans laid by Mr. Stoecklin, resident chief engineer, and for which funds have been provided by the Legislature, the requirements of the fishing interest and of trade at large claim an extension of the original scheme, which will have to be provided for by further grants of state money. These additional works are indicated by Roman numerals. They include (II.) a fishing boat harbor, with sixteen feet of water at lowest spring tides; (III.) a lock leading to (IV.) a wet dock, with a length of about 2,181 yards of available quays; (V.) shipbuilding and repairing yards and slips; (VI.) ground recovered from the sea which will afford building spaces for warehouses, offices, etc. X. shows the head of a lock intended to connect the future with the present port. It is meant to run through the battery (F), which will ultimately be leveled, and to open into the existing wet dock and the river Liane in its rear.—*London Graphic.*

NEW MARINE GOVERNOR.

THE engravings below illustrate a marine governor or anti-racer, the invention of Mr. Durham, of Barnet, which deserves more than casual notice. The objection to all the governors, save Durham's, that have yet been used at sea, lies in the fact that they do not anticipate the rise of the propeller out of the water, and that, as a consequence, the throttle valve is not closed till the mischief has been done. The Durham governor disposes of this objection. It is anticipatory; and in this lies its merit.

In all rotating governors hitherto used at sea, the throttle valve is moved gradually; that is to say, as the speed of the engines augments, the throttle valve is gradually closed, and for any given speed there is a corresponding position of the throttle valve, and a corresponding admission of steam. No such action takes place with the Durham governor. It has no effect whatever on the throttle valve until a certain velocity of engine is exceeded, and the instant this takes place the throttle valve is shut quite close as quick as lightning. This effect cannot be brought about by any arrangement of governor in which the shifting member acts directly on the throttle valve. Let the Durham governor be set, say for sixty revolutions of the engine per minute. It will take cognizance of all lower speeds, and will continually, but very slightly, shift its position, without affecting the throttle valve in the least; but the moment sixty revolutions are exceeded by even one revolution, the governor opens a steam port and admits steam above a small piston, which at once flies to the bottom of the cylinder, and instantly closes the throttle valve with a sharp jerk. But, furthermore, *it is not necessary that the engines should make more than one-twentieth of a revolution at the augmented speed in order to close the throttle valve*, and it will be seen on reflection that this being the case, the governor is virtually anticipatory, in that it feels the premonitory symptoms of racing, and interferes at once. The virtue of the instrument lies, not in the governor alone, but in the combination of the governor with a steam cylinder and piston. It is quite unsuitable for regulating the speed of engines; and it is not, indeed, properly speaking, a governor at all, but an anti-racer, as we have termed it. It is adaptable, however, and has been adapted to rolling mill engines, being so set that while the engine is making, say, seventy revolutions a minute, it holds the throttle valve closed. The throttle valve in this case is made to leak sufficiently to pass steam enough to keep the engine going whilst unloaded. The moment, however, a bar of iron enters between the rolls, the velocity falls to, say 69¾ revolutions, and at the same instant the throttle valve is pulled wide open with a jerk and full steam given to the engines. The instant the bar has cleared the rolls, steam is shut off again, and so the process is repeated. The invention has been fully tested in this way by Herr Krupp, at Essen, with a stone breaker, and there is no reason to doubt, or room to doubt, that the velometer acts as we have said.

So much premised, we may now proceed to describe the instrument in Mr. Durham's own words. A is the driving pulley, driving the bevel wheel B, which gears into the bevel wheels C and D, which wheels run on trunnions or arms on the square block E, the spindle F running loose in the block. The two wheels C and D gear into a fourth bevel wheel G, which is fast on the hollow spindle H, which spindle has also the wheel I fast on it, and drives the wheel J, which revolves the fan K; this fan runs through fixed diaphragms in the cylinder filled with water, thus securing extraordinary quickness and accuracy of action. The block E has fixed to it by the pin M the spindle N, which passe through the hollow spindle H, and has on it a sheave O, to which is fastened a chain P, which runs through a spiral spring Q. R is a small steam cylinder; the slide of which is connected with the spindle N, by the lever S; the piston rod T of this cylinder is connected by a lever with the throttle valve U.

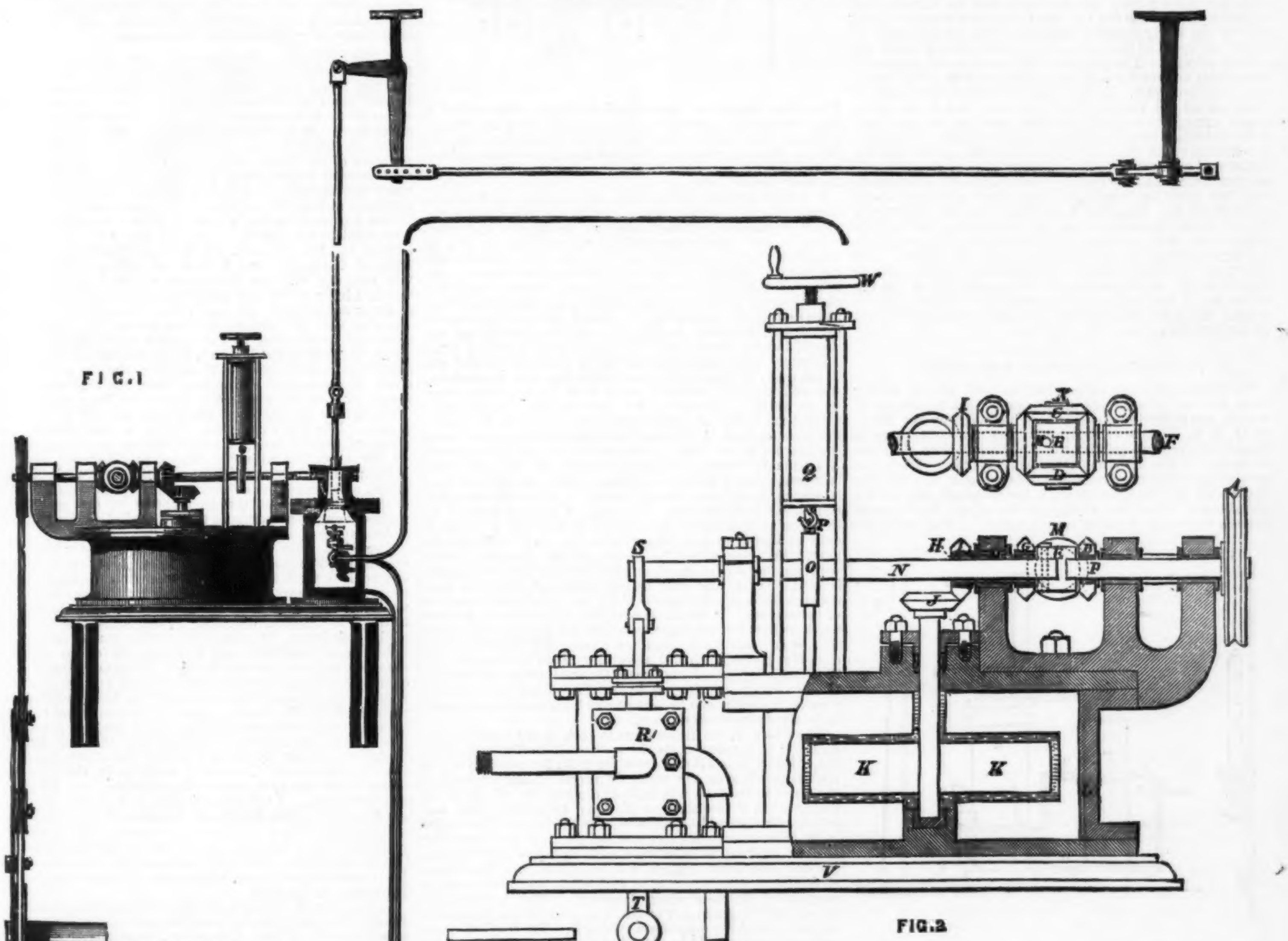
The action of the governor is as follows:—The speed is taken from the engine shaft to the pulley A, which through the wheels C and D drives the fan in the cylinder; the wheels C and D have a motion independent of that given by the wheel B, and are held in position by the spring Q, so that there is always an exact balance between the resistance offered to the fans by the water, according to the speed at which they revolve and the tension of the spring; any variation in the speed of the fans causes the wheels C and D to alter their position, and in so doing to move the slide of the steam cylinder R, allowing a little exhaust on one side of the piston, the movement of which instantly alters the position of the throttle valve U, and so regulates the speed of the engine with the greatest accuracy. The wheel W is for setting the governor to cut off at any required speed, and when once adjusted one revolution per minute beyond such speed is an absolute impossibility. X is a plan of the bevel gearing. The whole is firmly bolted on the bed-plate V.

It will be seen that the bevel wheels constitute a "jack-in-the box" or differential gear, and those who understand the peculiarities of this gear will have no difficulty in comprehending the action of the velometer. It is proper to add that Mr. Durham is substituting a flat spring for the vertical coiled spring in the governors he is now making, and thus reduces the dimensions of the machine; and it is not improbable that other modifications may be introduced in its external form. It can be fitted in any convenient position, on its side or upside down. But the most usual plan is to carry it on a couple of small brackets at the side of the engine room. The diagram Fig. 2 shows the way in which it is arranged on board the steamship Oceano.

NEW AND POWERFUL STEEL STEAM TUG.

Although we are aware that the governor has been fitted within the last few months to a large number of steamships, it must not be supposed that we have spoken so favorably of it without practically testing it. An opportunity of carrying out this was afforded to us on Monday, September 9th, 1878, when the Liverpool steam tug, Stormcock, made a run into St. George's Channel on purpose to show its powers. As the Stormcock is herself a remarkable craft, it will not be out of place to say a few words concerning her here.

In the early days of steam navigation, tugs found their sole occupation in towing sailing ships up and down estuaries or tidal rivers; they seldom or never went far to sea. All this has been changed, however, and the first-class tugs of the Clyde, Thames, and Mersey, undertake long voyages.



NEW MARINE GOVERNOR.

either to bring home disabled ships, or to take others to places wherein fair winds may be met with. For example, it is not improbable that the Stormcock may go to the Straits of Magellan, to bring home a large ship lying dismasted in a bay there, to which she was towed by one of our men-of-war on the Pacific station. More and more powerful tugs are being built daily, and it is not too much to say that the Stormcock is one of the most powerful, if not the most powerful, tugs in existence. She is the property of Mr. W. H. Hill, Liverpool manager of the Allan Line of steamers. She is 155ft. long, 25ft. beam, and draws 10ft. 6in. She is 90 tons register and 410 tons gross burden. She can stow 390 tons of coal in her bunkers. She is propelled by two pairs of compound engines, with cylinders 26in. and 45in. diameter by 30in. stroke, driving twin screws 9ft. diameter and 12ft pitch. Steam is supplied by two cylindrical boilers, each 12ft. 6in. diameter, with three furnaces in each. The boilers face each other, and are fired fore and aft. The aft boiler furnaces are fitted with Martin's patent fire doors, which are in high favor with the stokers. The boilers are of 1⅛in. iron. The engines indicate collectively 1200-horse power, and the speed of the boat is over 14 knots an hour. She is built entirely of steel, and she has a steel upper deck, without planking. She has two oval funnels, is schooner rigged, and far more resembles a smart gunboat than a tug.

As she is used now and then as a tender to the huge Allan Atlantic steamers, she has, forward, a deck saloon of steel plates, with a pilot house and promenade deck on top. The saloon is lined with oak, sand-papered, and slightly oiled, but not varnished, and decorated with blue wall tiles, set in frames. The fireplace is in the old English style, with a carved mantel-piece and brass mountings reaching to the deck overhead. The front end of the saloon is semicircular. Aft, ample accommodation is provided for the captain and first and second engineers, while forward there is a roomy forecastle for the crew. The Stormcock was built and engined by Messrs. Laird, of Birkenhead, at a cost of about £16,000, and does the firm and her owner very great credit.

On Monday the Stormcock left the landing stage, and went straight out to sea. Two Durham governors are fitted on board, one for each pair of engines. They stand on brackets bolted to the ship's side close to the condensers in the wings, and take up little room. They are driven by ½in. thick gut bands from sheaves on the ends of the crank shafts just forward of the high pressure eccentrics. The morning was wet and calm, but as the day wore on the rain ceased, and a stiff breeze sprang up from the south-west, and by the time the Stormcock was an hour at sea she began to get lively. She had comparatively little coal on board, as she was going into dock to get her bottom cleaned—for the first time, we believe, since she was launched in the end of 1877—and the tips of her propeller blades showed above water while she lay at anchor in the river. The result of the trial was in every way favorable to the Durham governor. So long as the engines kept down to about seventy-five revolutions per minute there was no racing, but the moment she began to pitch as she felt the seas the governor began to act; and we can safely say that while there was no approach to racing the speed of the engines was never reduced below the normal velocity. The governor did, in one word, just what a watchful engineer would have done, only it did it better and more promptly. The sea was not sufficiently rough to bring out all the virtues of the governor, but it was quite rough enough to make it perform; and on one occasion, when for experiment's sake the governor on the port engine was thrown out of gear, racing at once began, and with it the ominous slap of water in the cylinders showed that the boilers were being made to prime. It is fair to Mr. Durham to add that those on board—and they were numerous—who represented the engineers and shipowners of Liverpool, agreed among themselves that the velometer would effectually prevent racing, without the introduction of any countervailing disadvantage, an opinion in which we concur. The velometer is so simple that it requires little attention save to keep it oiled. A turn or two of the hand-wheel at the top of the spring box suffices to determine the number of revolutions which the crank shaft must make before it will act on the throttle valve.—*The Engineer.*

WATER-TIGHT DOORS FOR SHIPS.

To alleviate as much as possible the evil effects arising from the use of openings in the water-tight bulkheads of vessels, the following plan has been proposed by Mr. Riley, of H. M. S. Thunderer. By this plan the doors may be closed with greater quietness and quickness than they can be by any of the methods at present in use. Since the most serious results arise from not being able to close the doors with sufficient promptitude, the proposed plan has for its principal object the closing of the doors, the opening process receiving a minor consideration. The hydraulic

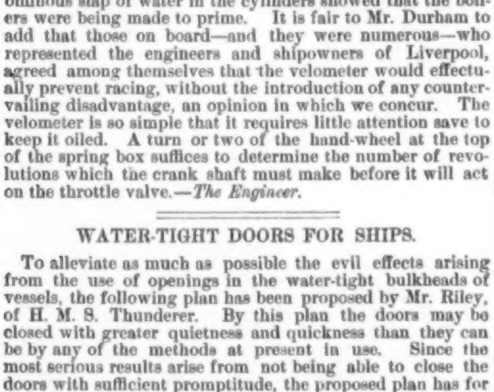


FIG. 1 FIG. 2

system is used; a system which has been applied before for the same purpose, but does not seem to have been taken full advantage of in the way of centralizing the process. In the proposed arrangement it is intended that the whole of the doors shall be under control from one central, secluded spot.

The system, as described, is applied only to doors which are raised and lowered to open and shut, as this kind of door offers peculiar advantages for closing. Most of the lower doors in present use in vessels are fitted in this manner, and if only these be brought under this method it would greatly promote safety, as if the lower doors were quickly closed, it would allow time to close the upper ones before the water would reach too high.

Referring to the accompanying diagrams, Fig. 1 represents the hydraulic cylinder and door; P is the pressure pipe at the lower end of the cylinder; a cock or pipe leading to the bilge is attached to the upper end to allow any confined air or water, which may be above the piston, to escape. The pressure pipes at the bottom of these cylinders run to cocks, P, P, P, shown in Figs. 2 and 3; these cocks being fitted in order to put these pipes, P, in communication with the tanks, T, through the branch pipes, *t*, or with the accumulator, A, through the pipes, *a*. The accumulator, A, is a reservoir of pressed water for raising the doors; it is pumped up by hand by the small force pump, M, the supply of water being drawn from the tanks, T, and forced into the accumulator by raising and lowering the lever, L. Each door has its separate pipe and tank, the object of which will be seen hereafter. Let us now suppose the doors open, held in position by confined water between the piston at the door and the cock, the latter being shut off. In order to shut them, turn the handle of the cock from the horizontal position, upwards to the vertical position, thus putting the pressure pipe, P, in connection with the tank through the pipe, *t*; the door will then commence to fall by its own weight and force the water from underneath the piston into its tank. All the doors may thus be shut by simply turning their respective cocks. In order to make the apparatus as simple as possible, the accumulator is made only large enough for raising one door at a time, as there is plenty of time for the raising operation. To raise the door, the accumulator is pumped up with the force pump, the water being drawn from that tank belonging to the door which is to be opened, by means of one of the cocks, K.

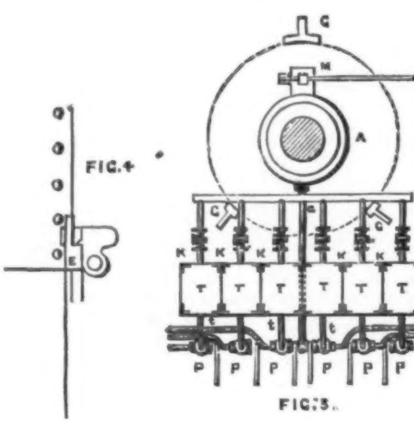


FIG. 4 FIG. 3.

When the plunger has been raised through a distance of 3 feet, the handle of the cock, P, is turned vertically downwards, putting the pressure pipe, P, in connection with the pipe, *a*, thus the pressure from the accumulator is transmitted to the piston at the door, raising the door as the plunger at the reservoir descends.

It will be noticed that the doors may be closed in the above manner at any moment without keeping or raising a pressure in the accumulator. It may, however, be objected that when a door is kept open by the confined water, the water will be subjected to such a pressure as will cause it to leak through the piston or glands. To prevent this, another element is introduced which will, in a great measure, do away with this objection, but at the same time will require a reserve of power to be kept in the accumulator. Check levers or catches are introduced, as shown in Fig. 4, capable of revolving upwards, but not downwards. When a door is raised to its full extent these catches are turned inwards into a slot cut in the door, so that the door as it falls may rest upon them, thus relieving the confined water from the pressure caused by the weight of the door. To close the door when these catches are in gear, it is necessary to turn the cock, P, putting the pressure from the accumulator on the piston, and raise the door 1½ in. or 2 ins.; in this ascent, the projecting piece, E, on the door raises the catch clear of the door, the catch being constructed so as to overbalance itself in this position; it, therefore, on being raised through a short distance, falls right away from the door. The passage for the descent of the door is thus made clear, and on turning the cock vertically upwards the door falls, forcing the water back into the tank. An accumulator, as shown in the sketches, loaded with one ton, 3-foot lift of plunger, 12-inch area of plunger, is capable of lifting over twenty doors of 800 lbs., each through the required distance of 1½ in. to relieve themselves of the catches. It would be advisable to use these catches under ordinary circumstances, when it is not probable there will be any serious reasons for closing the doors; though even if a necessity should arise they could be shut in less than two minutes. If, however, the weather is very stormy, or on entering an action, or in any like dangerous circumstances, it would then be better to let back the catches, ready to let the doors down at once.

The tanks, T, are divided one to each door to serve as indicators: as the door falls the water will be displaced from the cylinder above it and enter the tank, the position of the door depending on the water displaced. Thus the level of the water in the tank will indicate the position of the door, telling when it is closed, or if it is prevented from any cause. Care should be taken to keep the levels of the water in the tank at certain fixed positions, according as the door is open or shut; introducing a little now and then to supply any loss from leakage will be sufficient. The tanks should be graduated so as to read off at a glance the exact position of the door when lowering. The accumulator should also be graduated to serve as a guide for indicating the position of the door when raising it. The level of water in these tanks should be placed at or above the height of the piston when raised, so as to insure the cylinder beneath the piston being charged with water.

The catches mentioned could also be made to serve another purpose than that already given to it. If there are any compartments, having no egress independent of the doors in the bulkhead, a gong might be attached, so as to be struck by the catch on falling back, thus warning any who may be in the compartment to come out. G, G, G, are columns for guiding the weight on the accumulator.—*The Engineer.*

FOG SIGNALS.*

By J. R. WIGHAM

1. *Gas Guns as Fog Signals.*—The great importance to navigation of audible fog signals is now universally admitted. Among those which have been suggested are gas guns. Some years ago, when I was engaged for the Commissioners of Irish Lights in fixing gasmaking apparatus at several of their lighthouses in order that gas might be used instead of oil as the illuminant, it occurred to me that it would be convenient to use the gas available at such lighthouses for gas guns as fog signals. With the sanction of the Commissioners, I fixed gas guns of various sizes at Howth Bailey Lighthouse, and Dr. Tyndall and other gentlemen connected with the Board of Trade experimented with them. The noise of the gas gun is caused by the explosion of a mixture of oxygen and coal gas. We are all familiar with such explosions in the lecture room, but gas guns capable of producing a noise loud enough for a fog signal have only been tried, so far as I am aware, at Howth Bailey Lighthouse.

This mode of fog signaling has a very important advantage, viz., the gun may be fixed at the water's edge, or on a rock in the sea, at a considerable distance from a lighthouse or fog-signal station, and can be loaded and fired as often as required from the station without necessitating the light-keepers leaving their post, the noise of the explosion and the flash (in itself a good fog signal) being all the while at the point of danger. It is easy to imagine that such a point, say an isolated rock, might be too small to hold an ordinary gun, and be so inaccessible from the lighthouse as to render the attendance of a gunner almost impossible.

In order to show the section how these guns are used I have fixed one of small size in the College Park, which for the occasion we may call a dangerous outlying rock, and connected it by an iron tube with this lecture table, which we may call a lighthouse on shore. This gasholder contains the charge, which, of course, is gaseous, and not solid, as in the case of an ordinary gun. So soon as I have loaded the gun, which you will see that I do by simply opening a cock, I apply a light here at the shore end of the tube by percussion cap or otherwise, and the gun at sea is fired. It will be seen that the explosion very quickly follows the application of the light, so that these guns may be fixed at a great distance from a lighthouse or fog-signal station; a gas gun might thus be half a mile long. If the shots are required to succeed each other rapidly, any number of charges may be got ready to be successively used. I will now fire the gun which I have loaded.

I have only further to remark that the gun which you have heard is simply a piece of tubing 3 in. bore by 6 ft. long; the experimental gas guns at Howth Bailey are tubes about 18 in. bore by 9 ft. long, and are, of course, of enormously greater power. The sound of the Bailey gun is about equal to that of an 18-pounder cannon, and the expense of each shot of gas is also about the same as that of each charge of gunpowder for the cannon.

2. *The Irish Siren Fog Signal.*—I now propose to say a few words respecting another and perhaps the most important fog signal with which we are acquainted—the siren. In 1867, the United States Lighthouse Board made experiments with the first steam siren; the sound which it produced proved to be largely superior to that of the instruments previously in use—whistles, trumpets, etc. The Elder Brethren of the Trinity House and Dr. Tyndall subsequently made careful experiments with the American siren; and many instruments of the same kind have since been made and fixed at English lighthouses by direction of the Trinity House Corporation, by whom it is justly regarded as a most efficient fog signal. The siren has been so well described by Dr. Tyndall, Sir William Thomson, and Sir Richard Collinson, that I need not now describe it, and will only say that the instrument which I have here, and which I have called the Irish siren, is adapted either for steam or compressed air, and differs from those made in America and in England in being driven by a species of small turbine actuated by the current of steam or air by which the instrument is sounded, the rate of rotation being controlled and rendered uniform by a simple governor; a much less complex arrangement than the somewhat cumbrous mechanism which has heretofore been used. The Irish siren is applicable to steamships as well as to lighthouses. The first I made was similar to the American instrument, having two perforated disks, one revolving in front of the other, but with one important difference, that the holes in the revolving disk were constructed with beveled edges, and it was thus caused to rotate by the direct action of the steam without the intervention of any machinery, precisely on the principle of the original siren invented by Caigniard de la Tour.

The siren thus constructed is particularly suitable for steamships, being so simple that the smallest boy in the ship can set it to work in a moment by merely turning on the steam. This arrangement, though satisfactory for ships, was not so good for lighthouses, where the sound is required to travel to a greater distance. It was found that the speed of the disk became so great as to produce a note so high as to be almost inaudible; and although the dying shriek of the siren, as it approached the point of inaudibility, was peculiarly weird and unmistakable, and such as a few years ago would have been considered perfectly to have fulfilled the purpose of an effective fog signal, yet it was found to be inferior in range and power to that of the prolonged uniform note which is to be obtained by the use of some kind of driving machinery by which a regular rate of rotation of the disks is maintained. Instead of disks, as in the American sirens, I now use two concentric cylinders, one fixed, the other revolving. I believe that this part of the apparatus was invented by Mr. Slight, the foreman of the workshops of the Trinity House Corporation; but the chief peculiarity of the Irish siren to which I call your attention consists, as I have said before, in the simple means by which the cylinder is made to revolve, as will be seen by inspection of the instrument on the table.

As the song of the siren, if raised within the precincts of Trinity College, might be found inconveniently loud by the members of the British Association, especially by those gentlemen who might be in the act of reading papers, it was arranged to place it in the courtyard of the Royal Dublin Society's premises, and to sound it occasionally during the evening of the conversazione which was held there. It was doubtless heard by many of the members of the section who were present.

The great advantage which I claim for this siren above all other forms of the instrument with which I am acquainted consists in this, that from the compactness and simplicity of

* Read before the British Association, Dublin meeting.

the arrangements by which it is driven, and from the fact that it is not necessary that it should be united by belt or otherwise with any motive power, it can be sounded at the water's edge or on an outlying rock, or at any position no matter how distant from the station at which the steam boiler or compressed air receiver is situated.

IMPROVEMENT OF PRAIRIE ROADS AND STREETS.*

By T. J. NICHOLL, C. E.

THE great State of Illinois at present ranks among the foremost in the Union, and has, lying within its boundaries, the soil, the mineral, the fuel, and the intelligence, to make it not only the pride of every American citizen, but one of the most powerful States on the face of the globe. To bring such a state of affairs about, the very highest development of its immense resources will be necessary, which can best be accomplished by making the transportation of produce and manufactures easy and certain at all seasons.

The improvement of rivers, and the construction of canals and railways, have done, and are doing, a very great work in the right direction, but they will never be operated economically, or the full extent of their usefulness reached, until the proper improvement of our roads and streets is an accomplished fact. We might say that almost every atom and source of wealth of this great country has, of a necessity, to pass over country roads before it can reach the great commercial arteries we call rivers, canals and railways, and if for six months of the year these roads are impassable, as a natural consequence our business and prosperity must receive a check each year that can scarcely be calculated. This we know to be a fact, yet we do not acutely realize it, until we stand on the pinnacle of our possible attainments, and consider the present condition of our so-called roads.

Now, what I have said in regard to Illinois is equally true of its neighboring States, having used it simply as an example from my better acquaintance, and believing it to be a fair one. Bad roads are a great detriment to the advancement of civilization, and prosperity in any country, and a bad prairie road or street is certainly the worst in existence. This is pretty well understood by most members of our club, and the remedy, if there be one, should very properly emanate from us as a club, being representative of the engineering profession in the Northwest. To this end I hope you will impartially and thoroughly discuss this important subject, and arrive at some conclusion that may give the country, and towns and villages of prairie States, relief in this matter.

Having thus briefly opened the subject, I will proceed to give you some conclusions arrived at after having given the matter much careful thought and observation, believing that the remedy is not far distant, nor the cost beyond the present limit of the people's means.

FIG. 2.

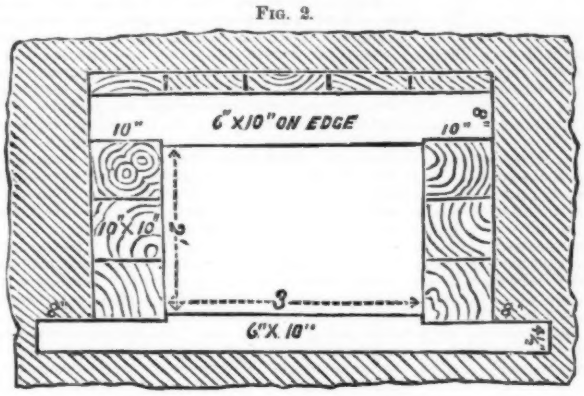
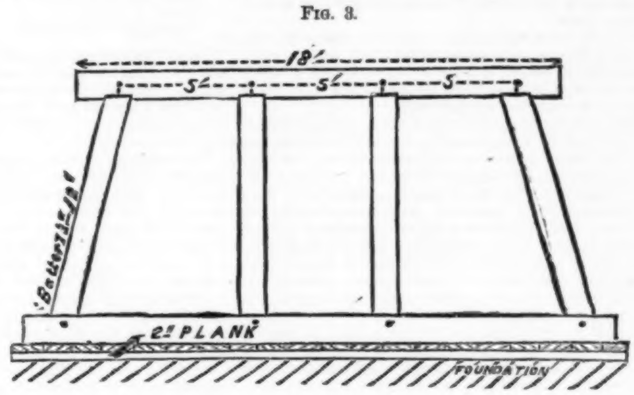


FIG. 3.

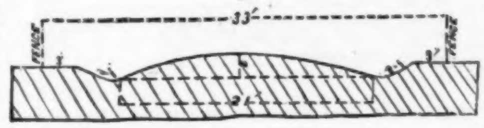


While the general surface of our prairies is flat, still there are undulations sufficient if properly used to carry off all the rain or water that may have accumulated in years past, to the Mississippi, Ohio, or other large rivers, and these undulations occur so frequently that main ditches would not have to be dug for any great distance to reach them. Thus it will be understood that good drainage, "the very foundation of good roads," is possible, and upon the possibility of the efficient drainage of our prairies I base the assertion that very fair passable roads can be made out of the soils we have at hand.

Public roads in the West are almost universally laid out sixty-six feet wide, about one-fifth of which is used, and the balance is allowed to grow up in weeds, which are vile smelling, unsightly and injurious, both to adjoining farms as well as to the roads themselves, keeping the surface damp, and making the ground porous, so that the first autumn rains make the road muddy, with no chance for the circulation of air and sunlight to dry it out. Thirty-three feet is ample width, except in some few cases, for a prairie road, measuring between the fences; this will give 3 feet on each side next to fence and 27 feet for roadway and ditches, which you will admit is more than is usually required. Sidewalks in the country are unnecessary, as tramps or other pedestrians generally take the center of the road; any space left for such would only grow up in weeds.

Fig. 1 will illustrate the form of cross-section proposed, except that I would change the radius of the arc used to suit the material and locality. For the ordinary black loam, where the country is comparatively level I would give the

Fig. 1.



arc a radius of about 30 feet; this as per Fig. 1 would give a filling in center of road about 1 foot, which would be 2 feet above ditches.

The ditches should be 1 foot deep, 1 foot on bottom, with outside slope 2 to 1, inside slope being that of roadway. Of course this idea can only be carried out on mostly level country, as in localities where land is rolling and broken or swampy, the surface will determine the depth of ditches and excavations and height of embankments; but in all cases ditches must have sufficient grade to carry water to first natural channel, and roadway be maintained to a width not less than 16 feet; in doing this more right of way would often be required. Now, having explained the form, I will state how I think work should be done, so as to make prairie roads passable at all seasons. First, I would have levels taken and grades of road and ditches established in much the same way as we do for a railway; would then make excavations and embankments in accordance therewith, using the plow and scraper and being careful to get embankments full, allowing two-tenths to a foot in height for settling; when this was done I would plow up the roadway proper in cuts and where the filling was light, harrowing or raking the surface to proper form, cleaning out ditches neatly with shovels. Now I would roll the bed so formed, with, say, a 2-ton horse roller, after which I would fill up any little unevenness or holes, and roll the whole with a 15-ton steam roller of the Aveling and Porter pattern, beginning in the ditches and rolling to the center, except on embankments, where it might be found necessary to roll the center first; but in this country there are so few places that would require embankments, that it is scarcely necessary to mention them; in the large majority of cases the ditches will afford all the material required to make the roadway. Roads of this kind should be made in the months of July, August and September, not later, and should be rolled twice or three times within a month after they are made. This will give them a proper time to harden and settle before the rainy season begins, and will reduce them to a compact mass the depth of one plowing, so that in an ordinary season a loaded wagon will scarcely make an impression, except immediately after a rain, and then only about one-fourth of an inch deep below the surface. Should small ruts form or dust accumulate, they should be filled and rolled again after first rain, as upon the compactness of the particles will depend in a great measure the durability of the road. Some of you may have serious doubts as to the soils of our prairies having the proper ingredients to shed water. I have not, having observed closely their use in the surfacing and building of railways.

The white clay of the oak ridges is very good, and as ballast, in my opinion, is next to gravel, and the regular black loam of the prairies is not far below it for wear and in shedding water. The soils are not so much at fault as has been the common method of using, or rather misusing them.

Early in spring or late in autumn are the times chosen for building country roads, because the farmer can best spare the use of teams, men, tools and time. They begin by plowing over a space about 10 feet wide, 15 or 20 feet from center on each side; the material thus loosened up is scraped toward the center without any particular regard to form in most cases, but occasionally they will level it off a little with shovels, or by dragging a railroad bar over it, and the road is complete. The consequence is, they try to use the so-called road, but as the wheels sink too deep in the soft earth, cannot, and the spaces from which the material was taken is used instead. After numerous trials and the effects of weather, the ill-shaped embankment gets solid enough to use, and makes a passable track until the rainy season sets in, when it is soon churned up into ruts and holes unfathomable, and is again abandoned for the side spaces, which do not last long, and the whole right of way becomes an impassable mud puddle until the dry season, when generally by use, but often by repairs, it is made good, by filling up with loose dirt, which a little travel after first summer rain soon churns out, making the road if possible worse than before repairs were made. Thus the people go on spending their money and working out their poll tax, getting no return except that which is against themselves in the way of wornout horses and broken wagons, not mentioning losses in the sales of produce, etc. How long they can stand this species of extravagance is for them to say.

So far nothing has been said in regard to culverts and small bridges, which are much needed and of a different style to those in general use on our public roads. The large bridges, being usually designed and built by reputable bridge engineers, are generally very good.

The first and most important things to be considered in bridging are the location and size of opening required; the former can generally be determined by the lowest ground, the latter requires a knowledge of the amount of water to be carried. My plan has always been to hunt up the oldest inhabitant and from him get an idea of the extent of the largest and most destructive freshet in his memory, or that he may have heard of. I then calculate the size necessary to allow such a flood to pass off, multiplied by two, and that is about as near as you can get to it, in the West. It is my opinion that, when a culvert is required at all, it should never be less than 3 feet wide and 2 feet high, so as to admit of its being properly cleaned out. I would build them as per Fig. 2, the walls being of 10"×10" oak 18 feet long, laid on mudsills 6"×10", 6 feet long, 4 feet between centers, gained down at ends to receive walls and keep them from closing in at bottom. The stringers or floor beams may be of same size, fitted in same manner and distance apart; ends being flush with outside of wall and bolted to same with one-half inch drift bolts, 10 inches long, to keep them in place; on these may be spiked a 3 inch oak or pine floor, and you have a culvert completed that will give you no trouble for 10 or 12 years.

FIG. 4.

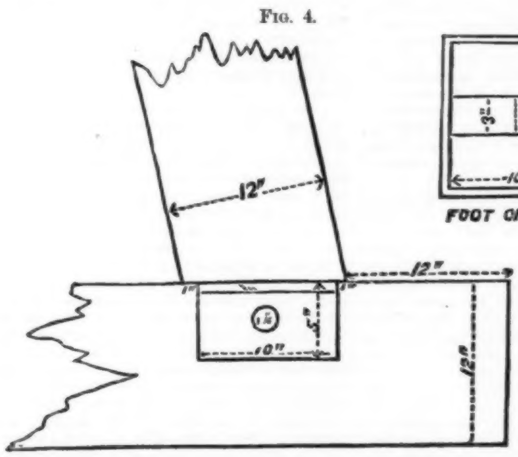


FIG. 5.

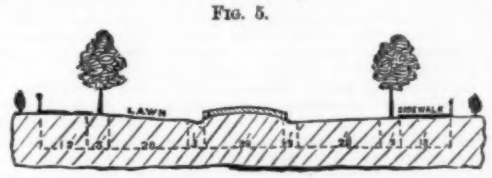
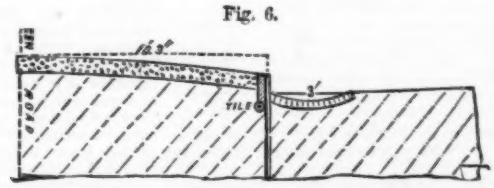


Fig. 6.



This same form of culvert might be used with some modifications (in size of stringers and use of three-fourths inch iron dowels in walls) to a height of 5 or 6 feet and 10 feet span, but where they are greater it will be economy to frame trestles of 8"×8", 10"×10", or 12"×12" timbers, according to height required, composed of 4 posts, cap and sill, the posts being mortised into cap 5 feet apart between centers, the two center ones perpendicular and two outsides with 3 inches to a foot batter, the sill being of sufficient length to receive them, and the whole put together as per Fig. 3. On these bents will rest the longitudinal beams or stringers, 4 in number, varying in size according to span, which should not exceed 20 feet, the most economical size for which would be 7" by 16". These should be drift bolted to caps, and the 3 inch floor spiked to them. All bridges having a span of 10 feet and over should be provided with substantial hand rail. The form of mortise and tenon I would recom-

* Read before the C. E. Club of the N. W., September 3, 1878.

mend, especially where exposed to weather, is shown in Fig. 4, which gives a good footing for post in case of tenon rotting, and at the same time keeps water out. I have touched upon the subject of culverts and bridges simply because it seemed necessary to make this paper complete, not for one moment presuming that anything I have said in that relation was new or original, except, perhaps, the form of mortise and tenon, which I have never seen or used except on bridges of my own design.

My great desire is to show the absolute necessity of the employment of skilled men to superintend the improvement of prairie roads as much as railroads or canals, and I have no doubt that the time is fast approaching when the public will be satisfied with such a course; until then we shall continue to have failures and immense sums outlaid in building unsafe structures by mere experimenters, and engineering as a profession getting the credit.

The exact cost of the improvements suggested in this paper is difficult to compute, some miles costing much more than others, but if we take, for instance, an ordinary mile of flat prairie, where the ditches will afford nearly all the embankment required, and averaging the bridging at 3,000 feet, board measure, the cost of road complete will be about as follows:

Engineering, laying out, and superintendence	$25.00
1,200 yards excavation of ditches, at 10c	120.00
Say 300 yards for extra embankment, at 10c	30.00
3,000 feet B. M. oak bridging, framed, at $30	90.00
Rolling	10.00
Cleaning up and leveling off	10.00
Total per mile	$285.00

Suppose that it cost $300 per mile, what part of this country but can well afford it? And I am sure that if my plan was once demonstrated to be a success, the money would be forthcoming, which I would raise by special assessment on adjoining property owners one mile each side of road to be improved, making a tax of only 18 cents per acre, or $18.75 on each 80 acre farm.

The cost of a 15 ton steam roller would be about $5,000, delivered. Cost of operating same, labor, fuel, and repairs, $5.00 per day; width rolled, 6 feet; average speed, 2 miles per hour; at this rate it is safe to estimate they will roll 2 miles per day over a surface 19 feet wide.

Roads made with these rollers will require repairs like all others, but will not be expensive, consisting of filling up ruts and holes with good material and rolling. In dry weather, when roads are good, the rollers can be taken off, and driving wheels put in their place, forming a traction engine. The cost of a machine so arranged will be about $500 extra, and will pay for itself in hauling gravel, cinders, broken stone, etc., for permanent way, or in moving the farmers' grain and lumber, while they are busy in the fields, planting or harvesting. Almost every township in the land could afford to own a roller, and pay a competent man to use and take care of it.

Now let us turn our attention to the streets of prairie towns, a fair specimen of which can be found in the capital city of Illinois. These streets are usually laid out 80 to 100 feet wide, of which 12 feet on each side is allowed for sidewalks, and the remaining 56 or 76 feet graded up for wheeled vehicles in much the same manner as described in the present way of making country roads—except that the gutters are not made so deep nor the roadway so high in the center, which on account of the extra width makes the roadway a great deal flatter. The lumps of earth thrown together are rarely broken, or the cross section reduced to regular form, and the consequence is, only a track about 7 feet wide is used, picked according to the best judgment of the first individual that may drive that way, and often winds from one side to the other once or twice in a block, while the balance of the street is unused, and remains in the worst possible condition. On such a street trotting is unknown, and owners of expensive turnouts feel thankful when they get through safe, even in the most favorable season, and when the rain comes the streets soon assume the character of an impassable quagmire, and wheeled conveyances are abandoned for two or three months. This is actually a fact in the city already alluded to, and there are many other cities whose streets would be equally bad, had they equal traffic over them. I think you will all agree with me, that 20 to 24 feet is ample width in small cities for roadway proper, outside of the business portions, where, of course, the whole width between sidewalks should be paved in the most approved manner, and upon this basis I will endeavor to explain my plan for the improvement of prairie streets, which, although I call it "my plan," is not entirely new or original, as you will at once notice.

In cities and towns the width of streets should, in my opinion, never be less than 100 feet, as the trees that may be planted on either side may then have room to grow without shading the roadway, and the houses being further apart, the ventilation and health of the place will be better. I would divide the hundred feet as follows:

Sidewalks	on each side 12 ft.	= 24 ft.
Tree space	" " 5 "	= 10 ft.
Lawn	" " 20 "	= 40 ft.
Gutters	" " 3 "	= 6 ft.
Roadway in center		20 ft.
Total		100 ft.

presenting a cross section as shown in Fig. 5, which will explain itself, so that we will pass to the construction of the roadway.

Along a line 10 feet 3 inches each side of the center of street I would set 4 x 4 inch oak posts boiled in coal tar, 6 feet apart between centers, leaning slightly toward center of street, 3 feet 9 inches in ground and 3 inches out, the tops forming a line 3 inches above and parallel to the grade of street; even with their tops and on the road side I would spike 3 x 12 inch oak plank on edge, the plank having previously been prepared by boring 2 inch holes along its center (so that two holes would come between each pair of posts), and boiled in coal tar. These planks would then form a sort of curbing or retaining wall on each side, between which the roadway is to be made. For the purpose of better drainage, especially in towns provided with sewers, I would lay 4 inch drain tile immediately under the lower edge of curbing on both sides as shown in Fig. 6, which represents the half of roadway proper.

The space between curbs should then be plowed and raked to the proper cross section, and afterward rolled with steam roller; this would compress the earth so that its upper surface would be four or five inches below the top of curbs, and the space thus left unfilled should be filled with the best material procurable, such as gravel, cinders, coal slack, clay, and sand, or, best of all, asphaltum pavement, such as is made by Mr. Abbott of Columbus, O.; and the whole well rolled with steam roller to proper rounded cross sections as shown in Fig. 6. The ditches or gutters I would place just outside the curbing; they could be cobbled, bricked, paved, or sodded, according to the means of the people or the requirement of the locality.

The next thing is the cost of such improvement. Counting that the blocks are 400 feet long, from center to center of cross streets, the cost of road ready for the finishing would be about as follows, for one block:

Engineering and superintendence	$20.00
Grading, ploughing, etc	30.00
2,500 feet oak plank, prepared at $20	50.00
135 posts, " 6c	8.10
150 lbs. boat spikes, at 3c	4.50
Setting posts and spiking on plank	15.00
Drain tile and laying 800 feet, at 3c	24.00
Rolling and sundries	5.00
	$156.60

The surface to cover with finishing material will be about 900 square yards, requiring about 110 cubic yards of covering.

	Per cubic yard.
Gravel will average about	$1.25
Cinders or slag "	1.00
Coal slack "	50
Sand and clay "	50
Asphaltum pavement "	10.00

Deducting one-fifth of expense, being portion done by city at the intersection of streets, and adding 5 per cent. for contingencies, we have for the cost of each foot of frontage the following: For

Gravel	$0.39
Cinders or slag	35
Coal slack	27
Sand and clay	27
Asphaltum pavement	1.65

These figures are exclusive of the cost of paving ditches and the construction of crossings and private carriage ways, which would be about the same as those in present use, except that I should be in favor of using 2x4 inch pine, or oak set up on edge, and spiked together, in preference to plank for the crossings.

The money for this purpose would be raised by special assessment in the usual way, and I think if the people once learn to their satisfaction that the work can be done so cheaply, they will not be long in availing themselves of the comfort of good streets and roads, and the railways will find it greatly to their interest to assist in this matter by hauling sand, gravel, and other suitable material at cost, to places remote from the natural beds of such; railways will get more than their money back in being able to get the grain all through the year, instead of it going off in a rush, as it now does during good roads, straining their carrying capacity to the utmost, or causing extra expense and loss in being compelled to own a much larger equipment than is necessary, which one half the year is idle.

In conclusion, let me say, that I trust you will discuss this matter thoroughly, and, if I am in error, shall be glad to be convinced of it; still, it will take considerable discussion to satisfy me that the plan is a failure, believing that thorough rolling or compacting stands next to drainage in making roads of all kinds, particularly those on the prairies and other like countries.

THE EDUCATIONAL VALUE OF CHEMISTRY.

By PROF. MAXWELL SIMPSON, M.D., F.R.S.

I HAVE been devoted to chemistry all my life. It has been my business and my pleasure. The longer I live the more deeply am I impressed with the advantages to be derived from its study, and I am anxious that these advantages should be shared by the rising generation.

Whether we take into account the value of the knowledge acquired, the discipline of the intellectual faculties in acquiring that knowledge, or the effect on the character, surely we have a right to give the study of this science a prominent place in our schools and colleges. It would be difficult to overestimate the value and extent of the knowledge we derive from chemistry. Without it we can know nothing about the air we breathe, the water we drink, or the food we eat; we cannot understand the processes of combustion, respiration, fermentation, putrefaction, or the endless chemical changes which are continually in operation around us, and which affect our lives for good or for evil. In a word, the whole of the phenomena of nature must for ever remain to us more or less an inscrutable mystery.

Again, is it not desirable that we should have some acquaintance with the chemical arts, from which we derive so many of our comforts and luxuries? Should we not know something of the arts of photography, dyeing, metallurgy—something of the manufacture of glass and china, and of the thousand beautiful things that are constantly in our hands? Not only is the knowledge we obtain from chemistry very considerable in itself, but it furnishes us with a key which enables us to unlock vast stores of knowledge contained in several other sciences—these are, physics, geology, mineralogy, physiology, and, I may now add, astronomy. Physics and chemistry are so intimately connected that it is difficult to say where the one begins and the other ends. The help that chemistry gives to physics is shown by the numbers of chemists who have distinguished themselves as physicists. I may mention a few belonging to our own time—Andrews, Bunsen, Faraday, Frankland, Graham, Guthrie, and Regnault.

With regard to mental discipline, the mind of the student is exercised in both the inductive and deductive methods of reasoning. His original faculties are stimulated by the consciousness that he can in many cases readily test the worth of his ideas by experiment. With inexpensive apparatus and a good balance the intelligent student can make out for himself some of the laws and many of the facts of the science, and, it may be, also add to them. He glides insensibly from the known to the unknown. Indeed his spirit of inquiry demands, in most cases, to be curbed rather than spurred. Some students are constantly finding out new methods of analysis, or discovering the precious metals in impossible places.

The readiness with which we can cross over into the *terra incognita* of chemistry and make little explorations there, constitutes, in my opinion, the great charm of this science, and, to a great extent, its value as an educational agent. What I wish to insist upon is, that the student of chemistry can reach the field of original work sooner than the student of most other sciences. Once he commences original research the development of his intellectual faculties rapidly progresses. His imagination is daily exercised in propounding new theories and devising experiments in order to ascertain their truth or falsehood. And what more valuable intellectual training can there be than the habit of subjecting our ideas to the test of inexorable experiment? In the world outside chemistry we are, alas! too ready to take things for granted. The chemist's motto is *prove all things.* The ancients adopted a different method. They assumed certain principles, and reasoned from them. They, therefore, did little in science.

Chemistry promotes in a remarkable manner accuracy, thoroughness, and circumspection. An organic analysis requires six weighings. If any one of these is inaccurate, the results are worthless. A qualitative test carelessly applied may cause us, in a research, to waste months in the pursuit of a phantom or Will-o'-the-Wisp which can have no corporeal existence. If we have to employ absolute alcohol in our experiments, we must not be satisfied with going through the ceremony of making it absolute, but we must assure ourselves that it *is* absolute. Unless we are sure of every step in our research, our results become doubtful, and therefore of no value.

On the circumspection also of the original worker large demands are made. The avenues by which error may creep in and vitiate his results are very numerous. These he must foresee, and endeavor to close up. Laboratory work teaches us to use our senses aright, sharpens our powers of observation, and prevents us from reasoning rashly from appearances. It also promotes manual dexterity, and trains the hands to work in subordination to the head.

Perhaps in no other science is the student so deeply impressed with the order and economy of nature, the immutability of her laws, and the exactness of her operations. These impressions will no doubt in after life impart seriousness to his character, and save him from the adoption of many a wild theory.

I come now to the effect of original work on the character. Many virtues are necessary to the chemist—courage, resolution, truthfulness, and patience. He is often obliged to perform experiments which are attended with great danger, and no man can hope to fight long with the elements without carrying away many a scar. Sometimes fatal accidents occur. Many years ago Mr. Hennel, of the Apothecaries' Hall, London, lost his life by the explosion of a fulminating powder which he was preparing for the East India Company. And many of us recollect the sad death of young Mr. Chapman, a distinguished chemist whom I had the pleasure of knowing, who was literally blown to atoms while working in the Hartz Mountains on a new dynamite which he had himself discovered.

I must tell the ladies, however, that accidents are not always so disastrous, but that often one may escape with merely the loss of an eye. But the chemist must not be discouraged by fear of accident, neither must he be disheartened by the temporary failure of his experiments nor at the slowness of his processes. Bunsen was obliged to evaporate forty-four tons of the waters of the Dürcheim Springs in order to obtain 200 grains of his new metal, cæsium. It took Berthelot several months to form, by a series of synthetical operations, an appreciable quantity of alcohol from water and carbon, derived from carbonate of baryta. Many years ago, in the laboratory of Wurtz, my honored master, a poor student whom I knew was carrying from one room to another a glass globe which contained the product of a month's continuous labor, when the bottom of the globe fell out, and the contents were lost. Nothing daunted, he recommenced his month's work, and brought his research to a successful issue.

Above all things, the chemist must be *true*. He must not allow his wishes to bias his judgment or prevent him from seeing his researches in their true light. He must not be satisfied that his results appear true, but he must believe them to be true, and having faithfully performed his experiments, he must record them faithfully. He may often be obliged to chronicle his own failures and describe operations that tell against his own theories, but this hard test of his truthfulness he must not shrink from.

But I must not weary you with the virtues of the chemist. If I have succeeded in showing that the pursuit of this science tends largely to develop the intellect and discipline the character, I think I have done something for chemistry. We are told by Bishop Butler that "habits of virtue acquired by discipline are improvement in virtue, and improvement in virtue must be advancement in happiness."

I am glad to see that the importance of original research as a part of higher education is at last beginning to be recognized in this country. The Royal University Commission at Oxford has recently recommended that candidates for the higher degrees in science shall in that university be required in future to work out an original investigation. In Germany, where education has been so long and so well understood, original work has been, for at least the last half century, a *sine qua non* for a degree.

Another admirable rule exists in that country, the adoption of which in Great Britain might go far to wash out the stain from our islands of not having contributed our fair quota to the advancement of human knowledge. It is this. The Germans make a point of securing invariably that their scientific chairs shall be filled by men who have already distinguished themselves by their discoveries. The professor on his appointment naturally desires to continue his investigations, and endeavors to secure, and usually succeeds in securing, the assistance of his pupils. This is a mutual advantage. The professor is able to do more work for science, and the student on his part learns to conduct for himself an original investigation. Hence there is always a rising generation of original workers in Germany who turn out papers more or less meritorious with the rapidity of a Walters press. They are stimulated by the hope of one day arriving themselves at a professor's chair, the path to which, they are well assured, is only through the toilsome field of original work. But I must not wrong the German student by the implication of a purely selfish motive in his work. His labor is one of love, and his ambition, for the time at least, is bounded by the desire to *do something* for science. And from a multitude of such enthusiasts the great professors come. Great mountains are only found in mountainous countries.

To detect apricot oil present as an adulteration in oil of sweet almonds, shake ten parts of it with one and a half part of dry slaked lime, heat it in a water bath to 212° Fah., and filter while warm. When the filtrate cools, an ointment-like mass is deposited if oil of apricots was present. [N. B.—Our correspondent, "Go-a-Head," and other the like learned men, call slaked lime "calcium hydroxide."

OXYCHLORIDE OF ZINC AS A DENTAL FILLING—COMBINATION AND THERAPEUTIC ACTION OF SOME FILLING MATERIALS.*

By D. D. SMITH, M.D., D.D.S., Professor of Mechanical Dentistry, Philadelphia Dental College.

WHO has not mentally asked the question, as he has taxed himself and his patient to almost complete exhaustion in some dental operation of unusual magnitude or length, Is there not some way either to prevent this destruction of tissue or to restore these organs when attacked, unattended by the severe mental and physical strain upon the operator, and the shrinking, dread, and suffering to the patient which the present general practice and teaching involve?

Is the popular impression true that generation after generation the teeth of civilization are degenerating, and their power of resisting decay lessening? And shall dentistry still persist in averting the evil by the use of one remedy, mechanically applied, in all cases and in all conditions?

Is there no consolation other than this that the profession can offer to the tens of thousands who have never shared its blessings, and to many others suffering abuse from burring engines, dental mallets, rubber dams, and other appliances, who are in doubt if it confers a blessing or a curse?

Has not the present aspect of dentistry a near parallel in the practice of general medicine of a few years ago, when calomel was of almost universal application? Every age, temperament, and condition felt its power for good or evil. Whatever the trouble, cerebral, thoracic, or abdominal, local or general, calomel as a remedy had its advocates. A generous and earnest spirit in medical science, aiming to relieve suffering and prolong human life, searching for cause and observing effect, broke the bonds of established usage and teaching; tried other means and remedies, until now, with the truly educated, mercury in any and all its forms is but an adjunct in general practice.

Medicine is not so narrow as to withhold its hands from remedies of merit, because, forsooth, they are not hoary with age and use.

Do not the broken arches and the edentulous mouths, continually presenting, plainly testify that dentistry as now taught and practiced is unable to cope with the diseased conditions of human teeth?

If the profession would avert this evil, observation must be more extended and accurate; new remedies must be sought and applied; investigation by experiment made popular, and the employment of other than mere mechanical remedies encouraged.

The deductions from the teaching of all our text-books, from periodicals and society discussions, point to the use of one filling material only in a given cavity—and that efficient in proportion as it is mechanically manipulated—for the treatment of all carious conditions and for the restoration of teeth.

If gold is recommended, the inference, if not the positive teaching, is that the filling, to be honestly and efficiently made, must be *all* of gold; if tin is the material, the cavity must be filled entirely with tin; and so also of amalgams, gutta-percha, and oxychloride of zinc. The exception to this is in some more recent and advanced teachings on the use of gutta-percha, tin, lacto-phosphate, and the oxychloride cements as coverings for exposed pulps; and different materials for use in roots, whatever may be adopted to complete the filling. It is not too much to say that any consideration or discussion of other filling materials than gold, of their composition or methods of use, of their behavior in varied conditions of the oral cavity or of their distinctive properties, has been evaded or frowned upon as too elementary and unimportant to engage the attention of writers or speakers. The desire to be known only as a "first-class operator" has held timid ones chained almost exclusively to the mechanical use of one material, and caused the loss to dental science of many an otherwise earnest investigator.

To inquire if some two or more of the present filling materials cannot be conjointly used in the same cavity for better preservation and greater comfort to the tooth; also to inquire if there may not be some hitherto unsuspected therapeutic action in dental oxychloride of zinc preparations, are the special objects of this paper.

That fillings fail because of lack of adaptation to the walls of cavities is a fact generally believed and admitted, and that gold is the most difficult material to *perfectly* adapt in many cases is also known and admitted. That the oxychloride of zinc cements are among the best, if not *the best*, preservatives in cavities of decay is a truth which will become as fully admitted when it is as well understood. If decay has ever been known to commence anew under an oxychloride of zinc filling when in place, the attention of the writer has never been called to the fact.

Chloride of zinc locally applied is recognized as among the most efficient agents known for promoting healthy granulations, as "in addition to its escharotic properties it appears to exercise a greater influence over the vital action of neighboring parts" than most other caustics; the separation of its eschar leaving healthy and vigorous granulations. It is equally efficient as an antiseptic and a disinfectant. As an application to chronically inflamed and suppurating gums at the festooned margins, after the removal of tartar, it probably has no equal. This liquid meeting so fully the indications for an antiseptic and a stimulant to the production of healthy tissue in a cavity of decay, mixed with the various preparations of oxide of zinc, forms a close and seemingly impervious union with the walls of cavities.

There are good reasons for the belief that these cements when properly manipulated not only exclude moisture, but that they do for diseased dental tissue what chloride of zinc does for more vascular tissue, viz., *stimulate the production of healthy structure* in the parts with which they are brought in immediate contact and in the near surroundings.

Illustration: Ten years ago a cavity of decay was filled on the mesial face of a left superior sixth-year molar with oxychloride of zinc and gold. The decay was deep-seated and involved the whole mesial face of the tooth. A portion of softened dentine was left covering the almost exposed pulp, and the oxychloride placed directly upon it. Enough of this cement was cut away to allow for the introduction of a gold filling to protect the walls of the cavity and the oxychloride. The tooth was of a character to decay readily and rapidly, but the only object had in view in filling the cavity in the manner described was the better protection of the pulp, by interposing a non-conductor between it and the gold. Something more than six years after it was deemed advisable to remove this filling for the purpose of gaining access to a small cavity in the distal face of the second bicuspid, which had been forced backward by occlusion until it rested in the concavity of the finished surface of the gold filling. The conditions were such that the removal of this filling permitted access to the cavity in the bicuspid without cutting or wedging, hence the adoption of the plan. Other fillings made entirely of gold and introduced about the same time in other teeth in this mouth had failed, and had been replaced in the meantime.

The dentine under the gold and oxychloride in question had undergone a decided transformation, changing from soft to hard and dense structure, seemingly capable of resisting decay without further protection. This exhibition of the beneficial action (as it seemed) of the oxychloride of zinc made a profound impression. And as its cautious use in all classes of cavities from that time to the present has given correspondingly good results, the most favorable conclusions have been formed for the practice of *lining* all cavities with an oxychloride cement, whatever the external filling is to be.

In many cases time can be saved in filling, the certainty of the operation increased, and the tooth rendered more comfortable to the patient; and further, thousands of pulps which under the all-gold system must be sacrificed or capped but to die under the filling, can by this method be comfortably and permanently saved.

The antiseptic and stimulating action of the chloride of zinc is of a most beneficial character, inducing in many cases better organization of the tissues in the living parts to which it is applied.

The manipulations in their simplest form consist in excavating a given cavity in the usual way and then filling entirely with some one of the best oxychloride of zinc cements—under the rubber dam if practicable. Having been allowed to set and harden for a few minutes, enough of the cement is cut away or excavated to form a cavity for securely introducing a gold surface filling. By this means the cavity can be nearly filled, or merely lined with the cement, and *it* kept from disintegration by a filling of gold. The color of the tooth is thus preserved, the pulp isolated from thermal shocks, and the preservation of the tooth more certainly secured.

In ordinary crown cavities, and in many cases of deep-seated caries in approximate cavities, this manner of procedure simplifies and shortens the operation of filling, but in small or shallow cavities complicates it. The cavity may be of such a nature as to render the conjunction impracticable. When such cases occur the cavity can be filled entirely with gold, tin, or any other filling material in the usual way. In deep-seated crown and other cavities where under-cuts exist, if the enamel is strong it need not be cut away, for when the decay is removed and the cement carefully and securely packed in its place, it forms a support when hard equivalent to true dentine. A cavity cut in it to a depth a little greater than the thickness of the enamel reduces the final filling with gold to an operation of the simplest character, as this new cavity has a hard, firm base of cement, and a boundary of cement and tooth material, or of the latter alone.

It may well be inquired if there are not some objections to the use of the oxychloride cements in the manner proposed. There is one objection, and it is believed to be the only one worthy of mention. It causes pain in the tooth immediately on application, varying in degree and duration with the extent of the decay and the character of the tooth. The sharpest and most prolonged pain is usually experienced in young or soft teeth, and its duration is from three to fifteen, and rarely to thirty, or even sixty minutes. The pain is greatly lessened or entirely obviated by dexterous and intelligent manipulation, which will follow a study of its peculiarities and its continued use.* Its extensive application for the past two years in all classes of teeth and cavities, as a covering for recently-exposed pulps and in hyperesthetic conditions of the dentine, has failed to develop an uncontrollable or even a markedly obstinate case of odontalgia.

Exposed pulps may be first protected with lacto-phosphate and a Weston cap, with an oxide of zinc *pad*, with gutta-percha, or in any manner which seems most desirable, and the cement placed over the capping used. The oxide of zinc pad is made by mixing the powder of any oxychloride cement with creosote or oil of cloves, using but a very small quantity of either liquid. By patting this mixture with a spatula it can be worked into a mass aptly termed a *pad*. This can be used as a covering applied directly to the pulp, or to prevent pain in deep-seated caries. It is unquestionable that the therapeutic action of the oxychloride is much diminished, if not completely arrested, by a covering of gutta-percha over the pulp, while the oxide of zinc pad modifies but does not prevent its action, and for this reason it is esteemed, and has proved in practice a better and safer capping for pulps than gutta-percha.

That the action of the chloride of zinc is not wholly interrupted by the *pad* is evident in the fact that the powder of which the pad is made becomes in a short time consolidated and almost homogeneous with the oxychloride of zinc used to cover it.

To recapitulate, we find the advantages of the oxychlorides as linings or as basal fillings, to consist in the saving of time; perfect apposition of filling material with the walls of cavities; solid base and actual support to frail walls; secure anchorage for metallic fillings; ready adaptation in places difficult or impossible of access with gold; no discoloration of the material itself, and a preventive of discoloration in dentine; comfort, especially to highly-organized teeth; a stimulant to the production of healthy tissue, and the most effectual preservative known in dentistry.

* Read before the American Dental Association, August 9th, 1878.

* It has been urged that the chemical combination which is the result of bringing together oxide and chloride of zinc destroys the therapeutic effect of the latter, but the fallacy of such reasoning is shown by the facts here stated; and further, an application of oxychloride of zinc carelessly or injudiciously made produces pain undistinguishable in character from that of chloride of zinc in the same place.

DISEASES OF THE DIAPHRAGM.

THE diaphragm is a muscle the functions of which are of such importance that it is a matter of some surprise that so little attention has been paid to its diseases. With the single exception of the heart, no muscular structure of the body is in such constant action, and no muscle has so great influence on the functions of important viscera. And yet until now very few observations have been made upon its morbid states, and the student will search in vain for any important facts regarding its diseases, with the exception of a few valuable and suggestive observations recorded in our columns some ten years ago by Mr. Callender. In the last number of Virchow's *Archiv*, however, is an account of some observations by Professor Zahn, of Genth, which show how frequently it is found diseased, how various are the morbid changes it presents, and which suggest very strongly that their influence may often be in a high degree prejudicial. It was, indeed, the observation of some cases in which slight bronchitis and emphysema, with congestion of organs, and simple, moderate dilatation of the right ventricle, seemed insufficient to account for death, but in which marked degeneration of the diaphragm coexisted, which led Zahn to study the condition of the diaphragm in other cases.

The result was the discovery that a degenerated state of the muscular fibers is by no means infrequent. The changes observed were of several kinds—simple brown atrophy, with proliferation of cells and nuclei, and granular clouding, with fatty and vitreous degeneration of the fibers. The former appears to be the more frequent, although the least important. It is not easily recognized with the naked eye, the muscular tissue appearing merely thinner than normal, and somewhat pale. The peritoneum covering it, when stripped off, has a brown color, and between the muscular fasciculi collections of fat exist. The microscope reveals greatly degenerated fibers, lying among others nearly normal. The former have lost their striation, and contain many granules and spherules, much less numerous than those which characterize fatty degeneration, and the smaller disappearing under acids. About the nuclei are accumulations of yellow granular pigment, sometimes separating proliferated nuclei. A peculiar protoplasm-like substance sometimes surrounds the nuclei, or lies in the muscular fibers, giving them a peculiar appearance, and in places occupying peculiar lateral bulgings of the wall, and these containing numerous nuclei. These bulgings may be so numerous as to be in contact. The proper tissue of the fibers so affected is always more or less degenerated. During two months Zahn met with no less than twenty cases in which this brown atrophy of the diaphragm was more or less marked. Almost all of the individuals presenting it were over fifty years of age; all were considerably emaciated; in most, other organs presented also simple atrophy; and in all the muscular substance of the heart presented distinct brown atrophy. The cause of death in most was senile emphysema and bronchitis, catarrhal pneumonia, or some tubercular disease of the intestine; in one cancer of the œsophagus. In all some causes had produced a state of chronic marasmus. Zahn conjectures that the condition of the fibers may have arisen from a degeneration of the contractile element and an imperfect attempt at restorative growth in the cells of the muscle.

The granular and fatty degeneration of the diaphragm gives it, as seen through the peritoneum, a pale and somewhat opaque appearance, and, when intense, minute yellowish spots may be seen among the muscular bundles. Microscopical examination shows that the degeneration affects almost all the fibers, and presents its usual appearance, the change in different fibers being, however, far from uniform. In some the granules are very fine and closely set. The muscle cells present no proliferation in young persons, but in the old fatty degeneration may be accompanied by cell-proliferation, with or without a deposit of pigment. Protoplasm surrounding the nuclei is, however, in this case crammed with fat-globules. This change Zahn found twice in nine cases, each individual being over eighty years of age. Callender recorded* six cases of fatty degeneration found in subjects of various ages. In all it was associated with marked fatty degeneration of the heart, while the other voluntary muscles were healthy. To these cases Zahn adds nine others, five over fifty and four under forty. All presented the traces of more or less bronchitis and emphysema, and some croupous pneumonia. In the latter cases there was no fatty degeneration of the heart, but in all the others the heart and the diaphragm presented the same change. Putting together Callender's and Zahn's cases, we have ten men and five women, and thus the affection appears to be more frequent in the male sex.

The third form of change—the waxy or vitreous degeneration of the fibers—Zahn has found in one case only, a middle-aged man who suffered from chronic alcoholism, and died of pneumonia. To the naked eye the diaphragm was normal, but under the microscope many fibers presented the change in its most characteristic form, while others were in a state of commencing fatty degeneration. No similar degenerations could be found in the heart or other muscles, but the liver was fatty.

The correlation of these changes with clinical symptoms has yet, in a great measure, to be made. One of the most important clinical facts is the great frequency with which degenerations of the diaphragm and of the heart coincide. The changes in the two muscles are similar in character, and occur for the most part at a time when muscular tissue elsewhere in the body is normal. The two structures have certain common physiological conditions. From birth to death they are in almost uninterrupted work, and each appears to suffer at the same time from the same general cause; and it may well be that the increased work which chronic bronchitis and emphysema throw upon the diaphragm and heart may lead, in some cases, to the occurrence of the simultaneous degeneration of the two structures, since in the heart the change is found most intense in that portion of the heart on which the greatest work falls—the right side. An explanation of the origin of the degeneration in acute lung diseases, in which commonly the heart is unaffected, is less obvious. All the conditions of muscular over-action tend, however, to produce hypertrophy, as well as, and even more than, degeneration. Whether in these cases the muscular tissue of the diaphragm is increased in quantity is a question that must be left for the present uncertain. The symptoms and consequences to which the degeneration give rise must also be ascertained by further observation. In many of the cases intense dyspnœa had existed during life, but there were in all other conditions to which this symptom might be, in part at least, ascribed. Virchow long ago pointed out that atrophy of the diaphragm increases greatly the effect of asphyxiating causes, and may determine the fatality of the least bronchial catarrh. Whether, however, we may suggest, this is true in cases in which the diaphragm alone is affected, the intercostals being normal, is a point on which further observation is necessary, and on which the phenomena of some cases of paralysis of the diaphragm throw some doubt. The point suggests, however, the desirability of a more careful examination than hitherto has been made into the condition of the intercostal muscles in other cases. This is also important as regards the question of pathogenesis, since if overwork plays a potent part in the production of the change, the intercostals should suffer in due proportion in the same cases.—*Lancet.*

* *The Lancet*, 1867.

EUCALYPTUS IN AGUE.

DR. H. P. ROBERTS, who is a regimental surgeon in India, gives his experience in the *Practitioner* with the tincture of eucalyptus. Over twenty cases of ague were treated by him with this medicine, but only nine of them gave sufficiently satisfactory results to serve as evidence for or against the usefulness of the remedy.

FOOD PRODUCTS.—PARIS EXHIBITION.

SOUPS AND TABLETS.

WE notice some products exhibited and manufactured by "La Société des Potages Economiques," the "French soups," prepared in accordance with the method patented by Dr. Gannal, and under his personal superintendence. The soups consist of a "bouillon" so concentrated that when combined with certain vegetable and farinaceous substances, and the whole mixture properly dried, it assumes a solid form. Reduced to the density of 1·230, the bouillon is solid when cold, and liquid when hot; mixed then with vegetables, or other alimentary substances, it forms a kind of pasty mass, which is soft and easily compressed into tablets. These become solid when cold, and can then be completely dried on the stove without alteration of form. The tablets after their complete desiccation are coated with the same bouillon, which, when dried, aids in their preservation, and adds to their good quality. The number of combinations which may be made with the concentrated beef bouillon and other alimentary substances is very great, but the following are some of the principal: with rice purée, with rice and mixed vegetables, with rice and haricot beans (Prince Condé's favorite dish), with mixed vegetables (Julienne), with semoline, with Italian paste, with Brazilian tapioca, with pearl tapioca, with wheat flour—forming an article specially prepared for invalids, and called "fromentine." We have carefully examined the whole of the above varieties of soups, and found the quality of all excellent, and their state of preservation perfect. A further recommendation of these soups is their cheapness This is not the first occasion on which we have expressed a favorable opinion of these preparations, and we are glad to find that that opinion has been fully sustained by the manner in which they are appreciated by the public. These soups are prepared with so much taste and delicacy that they would prove acceptable even to the most fastidious invalid.

DRIED VEGETABLES.

This will now be the most fitting place to notice the dried vegetables of the firm of Messrs. Prevet et Cie., late Chollet et Cie., since these are also prepared under the patent of Dr. Gannal, who has justly earned a high reputation by the ability and ingenuity he has displayed in devising methods for the preservation of animal and vegetable substances. The vegetables, and even fruits, to be preserved are dried in such a manner as to allow of their recovering, when immersed in water, their former size, consistence, taste, and color. In this state, when properly packed, and not exposed to damp, they will keep for a very long time; and when it is remembered that most vegetables and fruits contain from 80 to 90 per cent. of water, nearly all of which is removed in the process of drying, it will be obvious that the advantages of the process as regards weight and transportation must be very great. This method of preservation has now been tested for some years, and with very satisfactory results, and these dried vegetables are very largely consumed in the French army, navy, and merchant service, as well as in very many private establishments. They are often cut into thin slices, different kinds being mixed together, and this mixture is much used for making Julienne soup, which may thus be prepared at all seasons of the year. We are surprised that more use is not made in this country of these vegetables, especially in the preparation of soups in winter, when fresh vegetables are dear and comparatively scarce.

SOUP BALLS.

Having thus described the soups and vegetables prepared under the patents of Dr. Gannal, we will in the next place make a remark or two on some "Boules de Légumes," or balls intended for soup, fabricated by Mons. F. D. Wasilewski, of Bourbon. These boules consist of the usual vegetables and substances employed in making soups, sweetened with a little sugar and containing a small quantity of brown coloring matter, the whole being moulded into little balls of the size of ordinary forcemeat-balls. When immersed in the soup and slowly boiled in it for some time, the balls fall to pieces and disclose to view the vegetables, in a fragmentary state, of which they are so largely composed. These boules retain, of course, the flavor of the vegetables from which they are prepared, and, being well dried, will keep for a considerable time. Their use is specially recommended among troops and on board of ship, where in many cases it is not possible to obtain fresh vegetables. Used under such circumstances, they are, of course, antiscorbutic.

PREPARED BEANS.

The next article we will notice is an "Extrait de Légumes," prepared by Madame Laurencel, of Montrouge, near Paris, for the coloration of soups, sauces, and ragouts. The extract, called "Dulcicolore," is put up in small masses like beans, each bean wrapped in tinfoil, and one of which is sufficient to color a large quantity of soup. The preparation is carefully made, and cooks no doubt will find it very useful.

CRYSTALLIZED FRUITS.

A very considerable industry of France consists in preserving different kinds of fruit by a sugar process, in which the sugar is made to crystallize on the surface of the fruits, giving them a very pleasing and brilliant appearance. Those who judge of this process by the few boxes of crystallized green gages occasionally seen in the shop windows in London, would form a very imperfect idea of the extent and character of this method of preservation. It is in the south of France that it is carried out to the greatest extent and brought to so much perfection, for it is there that the rarest kinds of fruits are to be most abundantly obtained. Among the kinds thus crystallized are unripe oranges and lemons, pine apples, figs, green almonds, apricots, cherries, chestnuts and many other descriptions of fruit. These are beautifully arranged in very handsome boxes, which form objects of great attraction in shop windows, and are largely purchased as presents for friends both at home and abroad.

One of the best-known preservers of crystallized fruits is Mons. Nègre, whose factory we visited two years since at Grasse, near Cannes. He is also one of the principal exhibitors in the Exhibition of fruits thus preserved.

DRIED FRUITS.

Another industry, still more considerable, is that arising out of the preservation of certain kinds of fruits by the simple process of desiccation. It is by it that the well-known French prunes or plums, which grow chiefly in the Lot-et-Garonne, are preserved, as well as the Normandy pippins. Mons. Gérard St. Blancat, at Le Bouscat, near Bordeaux, has a large manufactory for the preparation of fruits by this method, and he is one of the chief exhibitors in this class, especially of samples of prunes. Another exhibitor of dried prunes is Mons. A. Crespy, of Agen, which is in the midst of the plum district.

DRIED APPLE SAUCE.

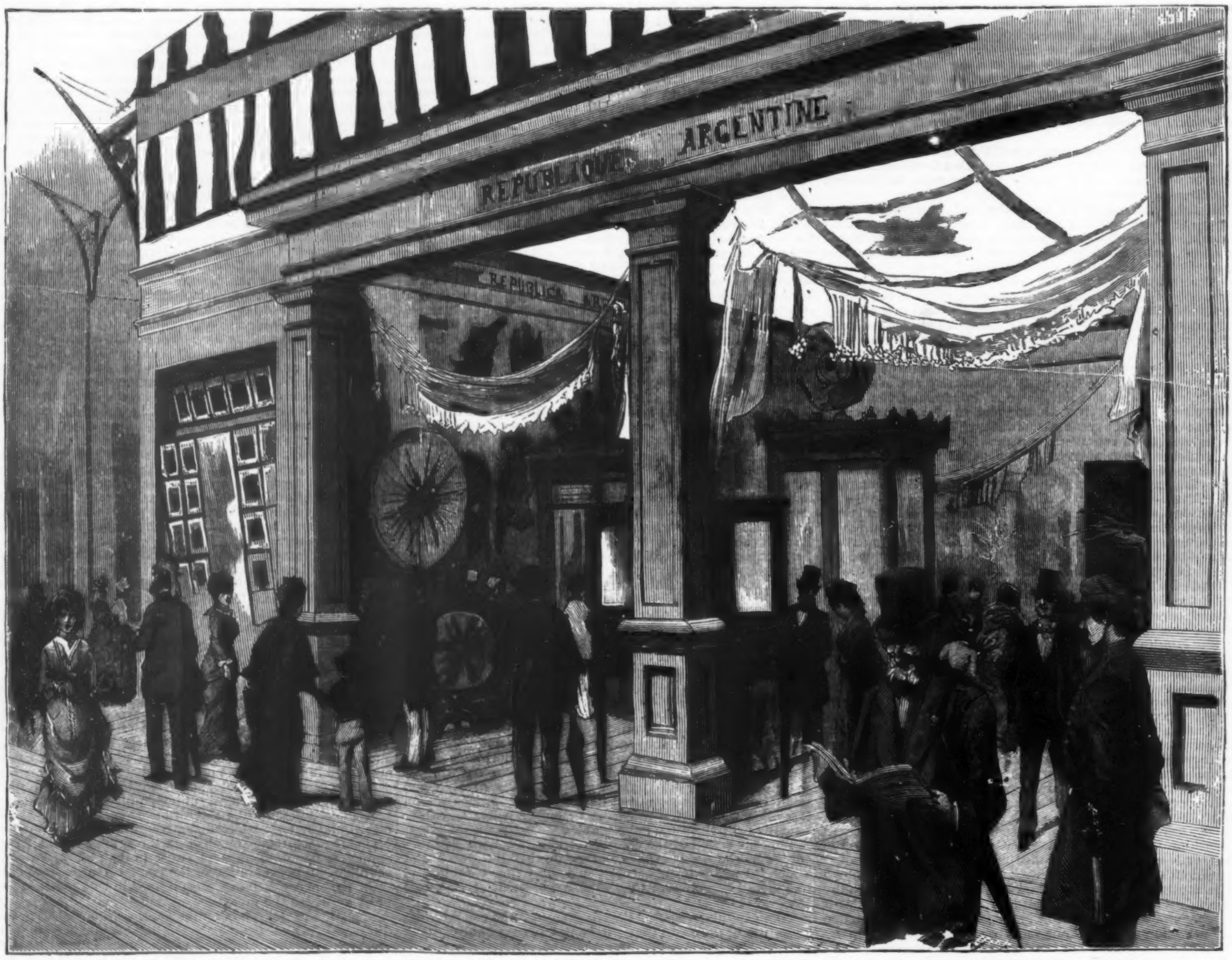
Mons. Blareau, of Awargnies le Petit, exhibits a somewhat singular preparation of a dark, reddish-brown color, in flat sheets or cakes, resembling somewhat chocolate, called "Pâté de Pommes." These cakes consist of cooked and dried apples, prepared, according to the inventor, in the following manner: The apples are cooked in their own juice by steam, passed through a sieve, dried and cut into sheets or small pieces ready for use. In this state it is said that the pâtés will keep ten years, and they are specially recommended for use in the navy. They may be eaten dry, or when diluted with water and boiled, as a compot, which replaces very satisfactorily the fresh apples, and is of course available at all times of the year.

DRIED EGGS.

Mons. Léon Defer, of Paris, exhibits an article which consists of the dried albumen or white of egg in the shape of a coarse powder. The albumen is dried at such a low temperature that when cold water is added to it, gradually heating the mixture at the same time, it readily dissolves, the albumen reacquiring its original properties, and the solution when thus treated becoming frothy and viscid. One kilogramme of the powder is said to contain the whites of three hundred eggs, and it forms a convenient and very suitable material for clarifying soups, coffee, and many other articles of the *cuisine*.

GELATINES.

Among the exhibitors of gelatine are Mons. Foullon, of Nanterre, and Mons. Perreau, of Paris. The latter manufactures the article in several forms. One of these is in thin almost colorless sheets intended for the preparation of jellies and blanc-mange. Another, also in sheets, is of a beautiful rose-red color, designed for the coloring of jellies and confiture de Groseille. Other sheets exhibited are for the stiffening of lace, tulle, etc., and straw hats. Some,



THE PARIS EXHIBITION—EXHIBIT OF THE ARGENTINE REPUBLIC.

again, are of a beautiful violet color, and these are intended for ornamental purposes. Lastly, very thin, smooth sheets are specially prepared for covering, protecting, and glazing cartes de visite and engravings.

Now the manufacturer of gelatine, as the result of his processes, and with a view to utilize all the material upon which he operates, necessarily becomes the maker of a variety of other articles. Thus the feet of oxen contain not only gelatine, but also a great quantity of oil; hence he prepares from them a "Huile de Pieds de Bœufs," while the bones of the feet yield phosphate of lime. Then from the refuse he is necessitated to prepare an inferior gelatine called "Gelatine Colle" or glue, what still remains being ultimately employed as manure. So that operations of considerable importance have to be carried on in a gelatine manufactory concurrently with the preparation of gelatine.

FRENCH CONFECTIONS.

The French have long been noted for the excellence and delicacy of their manufacture of sugar confectionery, and this reputation is well sustained by the exhibitors. Among those firms who exhibit in this department are Mons. Colin, of Nancy, a maker of very beautiful dragées; Messrs. E. Gentils, Vincent et Cie. Paris; Mons. Michel Legros, Limoges; Mons. Raingo, Paris; Mons. Seugnot, Paris; Mons. J. Sigaut, of Gentilly; Mons. J. Tavernier, Paris; Mons. A. Tremblay, Paris, whose specialty is the manufacture of pâtés de gommes; and Messrs. Jacquin et Fils, Paris, whose dragées were most beautifully and delicately made and colored. In France, a stringent law has long been in operation against the use of metallic and other injurious coloring matters. From the examination of the above bonbons and those of other manufacturers, it would appear that this law is rigidly observed and enforced. Mons. Legros manufactures barley-sugar and marshmallow lozenges, this latter description of lozenge being much used in France. He prepares these, according to the old formula of his predecessors in the business, with pure cane sugar, and not with glucose, which impairs their flavor as well as their keeping properties.

NOUGAT.

Mons. Seugnot states that he is the first who has distilled the extract of fruits for the manufacture of the bonbons made by him. Mons. Sigaut exhibits a sweetmeat little known in this country—viz., "Nougat." Of this we examined two varieties, one "Nougat fin," and another "Nougat aux pistaches à la vanille." The flavor of both was exceedingly nice, and the latter even delicious. The distinguishing character of nougat is that it is made with a fine, smooth paste composed of sugar and pounded almonds, interspersed with larger pieces of sweet almonds and pistachio nuts, with often a flavoring of vanilla, the whole being dried and pressed into cakes of various sizes. Altogether nougat is one of the very nicest and most delicate sweetmeats with which we are acquainted. Messrs. Raingo et Cie. prepare honey lozenges, Venetian barley-sugar, English bonbons, and nougat of Tunis.

PURE LICORICE.

Monsieur Noël Delon, fabricant of Nimes (Gard), exhibits the wood or root of licorice, and samples of the inspissated juice. He claims for the juice that it is absolutely pure and free from all adulteration—a very great recommendation, for there are few articles known to us more liable to contamination and sophistication than licorice. The samples of Mons. Delon's manufacture, which we have examined, fully support the statement of the maker as to their purity.

Other makers of licorice are Messrs. Carénou and Tur. These gentlemen have two manufactories, the one in Saragossa in Spain, the other at Monusac in France, where they claim that their predecessor established the first manufactory in France for this branch of industry. They state, in a communication with which they have favored us, that at their works in Spain they employ 2,000 people, and that the value of the produce of their two manufactories amounted in the year 1877 to more than a million and a half of francs.

CHICCORY.

France is a great chiccory-consuming, and, by consequence, a great chiccory-growing, country. There are several exhibitors of this root in all forms and conditions. There is no doubt that the real reason of the general use of this vegetable is based upon the saving of coffee effected by it. It is certainly no proper substitute for coffee, since it does not possess the peculiar and valuable properties of that berry, although it is so often made to take its place. It does not even, in our judgment, improve the flavor of coffee when added to it, while it certainly diminishes its aroma and dietetic properties just in proportion to its admixture. One or two of the manufacturers of chiccory likewise exhibit a coffee substitute made from acorns—"Glands doux." In appearance this article resembles coffee, but, of course, it possesses neither the essential oil nor the active principle, caffeine. The beverage prepared from it, when mixed with sugar and milk, may be, to some extent, palatable, and, from the tannin contained in it, may exert a tonic effect. Acorn coffee was formerly much made in Germany, and even given to children. Under the microscope the powder of the roasted acorn presents several structural peculiarities, whereby, as was pointed out many years since by Dr. Hassall, it may be readily discriminated. Even in England the use of acorn coffee was not unknown. After all, it may be said that there is nothing really injurious in this so-called coffee substitute, or in many other torrefied substances which have been recommended and employed from time to time instead of coffee. The points to be remembered are, that they possess none of the properties of coffee, and that they ought not to be mixed with the coffee without the knowledge of the consumer, or sold at anything like the price of coffee.

COFFEE SUBSTITUTES.

Mons. Curel, of Paris, exhibits substitutes of coffee, of which we have heard before, prepared from figs, and which he denominates "Figuine Curel" and "Essence de Figuine." The prospectus concerning the former is headed "Trésor des ménages! Santé! Force!" and it goes on to state that the figuine, of which the name alone explains the origin, is the product of many varieties of choice figs from Provence, Asia, Egypt, Spain, Naples, etc. Figuine, no doubt, imparts to the beverage made with it color, a certain bitterness, with sweetness, and thus furnishes a beverage which some may like, and which, when mixed with coffee, doubtless renders the latter less heating and exciting, and, consequently, better adapted for children and some invalids than coffee alone.

Contrary to what might be anticipated, there are comparatively few exhibitors of coffee; among them are the following: Mons. Barlérin, of Tarare (Rhone); Mons. Cahan, Pharmacien, Paris; Mons. E. Choveaux, Paris; Mons. Coudure, Bordeaux; Messrs. F. B. Fraschina et Cie., Marseilles; M. Jaliageas, Angoulême; M. Savigny, Chartres; and M. Trébucien Fils, Paris.

Possibly the reason why there are not more exhibitors under this head is to be found in the fact that almost every householder daily roasts and grinds his own coffee, a circumstance which fully explains the excellence and superiority of French coffee.

Mons. Barlérin exhibits a preparation which he calls "Café Barlérin." This is evidently a compound of which coffee forms one only of the constituents. According to the inventor, it will cure most of the diseases to which flesh is heir.

Mons. Cahan exhibits an essence of "Café de Trablit." It possesses very remarkably the odor of coffee, and is so strong an extract that two teaspoonfuls are sufficient to make a large breakfast cup of coffee. Prepared in the manner directed, it furnishes a really excellent beverage, and the preparation will be found a very useful one in cases where the saving of time and trouble is an object.

SUGAR COFFEE.

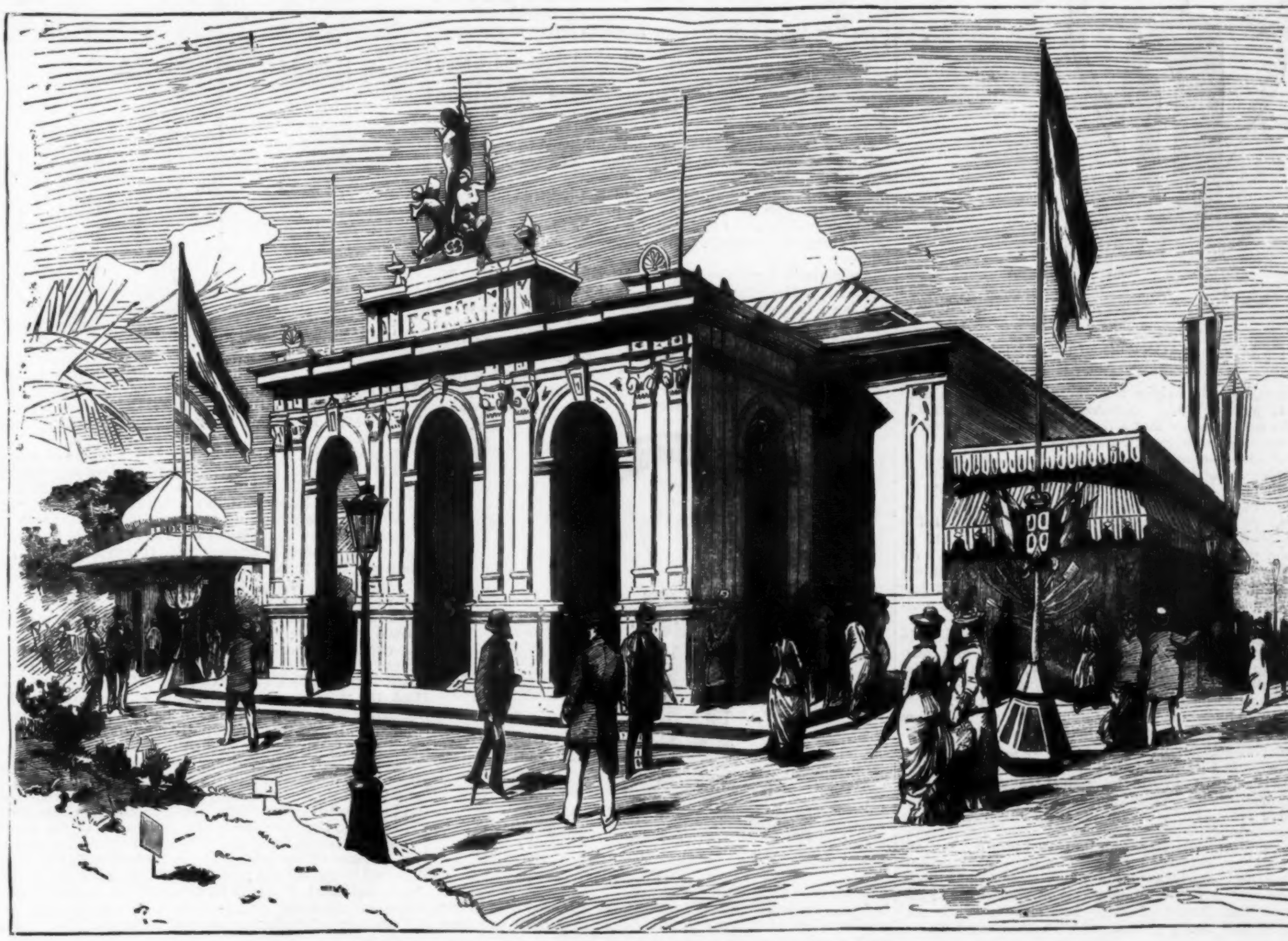
Mons. Savigny exhibits a coffee which bears his own name, and is called "Café Savigny de Chartres." It is described as a combination of the best coffees, torrefied with 10 per cent. of sugar. We have examined this coffee microscopically, and find that it consists entirely of coffee, with the above-named addition of sugar. The sugar attracts moisture, and so causes the powder to become clogged or caked, and thus may contribute to the preservation of the aroma of the coffee. The torrefied sugar, being exceedingly soluble, quickly imparts to the infusion made with the Café Savigny a rich brown color, and gives it at once the appearance of strength.

CHOCOLATES.

Chocolate is consumed in France to a much greater extent than in England. It consists, in nearly all cases, of cocoa and sugar pressed into the form of cakes; while the article which we principally use in this country, and which we call cocoa, is almost unknown in France. Chocolate is in England looked upon with some misgiving and even disfavor, and yet we believe it is a much purer and better article than many of our cocoas, although it must be acknowledged it gives more trouble in the preparation. The aromatic principles of the cocoa are better preserved and longer retained in the form of cake, which, moreover, does not admit of adulteration to the same extent as cocoa in a state of powder.

There are many well-known exhibitors of chocolate in various forms, the following being some of the principal: Messrs. Caron (late Alglave), Paris; Mons. Choquart; the Chocolat des Colonies Françaises, Paris; Mons Derossy, Paris; Mons. N. Drillon, Paris; Mons. Guillon (Chocolat de la Compagnie Parisienne); Mons. Ibled, Paris; Messrs. Louit Frères, Bordeaux; Mons. Mason, Paris; Mons. Menier, Noisiel-sur-Marne; and Mons. Trébucien, Paris.

We shall notice the products of but few of the above-mentioned manufacturers, these being in many cases so well known. Mons. Caron exhibits a "Chocolat à l'Extrait de Viande de Liebig" in cakes and pastilles. This chocolate is very nicely and delicately prepared, and the smell and taste of the extract are so completely masked by the chocolate that the preparation may be recommended to the most delicate palate. Messrs. Louit Frères exhibit different qualities and kinds of chocolate under the name of "Chocolat Louit." One of these, of very fine quality, is called "Chocolat des Dames." The system pursued by this house in printing the price of each tablet on the outside of the wrapper is a very excellent one, and affords much protection to the public.



THE PARIS EXHIBITION—THE PAVILION OF SPANISH AGRICULTURE.

Messrs. Louit warrant their chocolates to consist simply of a mixture of cocoa and sugar, the relative qualities of these varying according to the price. In their prospectus they remark that "the price indicated upon each tablet refers to the quality of the chocolate, and the purchaser is requested to observe that the label with the price be intact, this precaution being the more necessary as, with or without intention, one quality might be substituted for another." Mons. Menier, having also a manufactory in England, is an exhibitor in both the French and English sections of the Exhibition; we will reserve our remarks on the chocolates of this well-known firm until we come to treat of the English exhibits.

Mons. Trébucien exhibits a "Chocolat des Gourmets" and a "Café des Gourmets," neither of which have we examined, but they are much advertised in Paris.—*Lancet.*

THE ELECTRIC LIGHT.

Lecture delivered at the Stevens Institute of Technology, by President Henry Morton, before the American Gaslight Association.

The problem of practical electric illumination is essentially one of magneto-electricity, or the production of currents by mechanical force, the battery being no longer used for this purpose except as a matter of scientific rather than

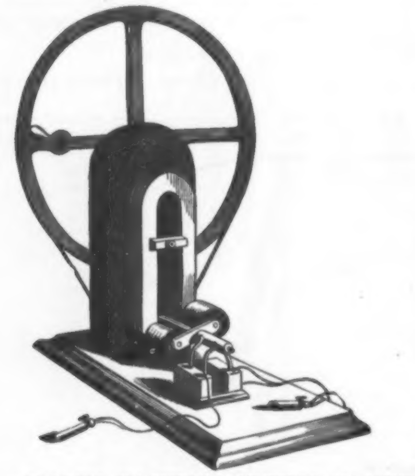


Fig. 1.—CLARK'S MAGNETO-ELECTRIC MACHINE.

practical interest. Its origin may therefore be said to date from 1831, when Faraday discovered magneto-electricity. He was the first to show that a magnetic bar introduced in a coil of insulated wire caused a current of electricity in it, and he was also the first to construct a machine in which currents were formed in a metallic disk revolved near the poles of a magnet. These currents being in opposite directions for the two halves of the revolution, they could not be utilized, where constant currents were required, until the invention of a device called a commutator, by means of which they were both thrown in the same direction. As soon as Faraday had shown the way, numerous inventors (Pixii, Saxton, Clark, Nollet, etc.) constructed more or less serviceable machines for the production of electric currents.

In 1832, Pixii, a manufacturer of scientific instruments in Paris, constructed a machine consisting essentially of a magnet revolving in an upright wooden frame, so that its poles moved directly under two bobbins containing soft iron cores. The power was applied by hand by means of gearing.

Saxton's machine, made the same year, differed from Pixii's, in having a stationary permanent magnet in a horizontal position, and revolving coils of wire before its poles. Four years later Clark, of London, constructed a machine (represented in Fig. 1), in which the steel magnet, consisting of several horseshoes bound together, is upright, and two coils revolve before it. Its principle is exactly the same as that of Saxton's.

For a time it seemed as though increased power were obtainable only by increasing the size of the machines and multiplying their parts, a notion which reached its climax in the so-called "Alliance" machine, constructed under the direction of Prof. Nollet, of Brussels. This unwieldy machine consisted of ninety-six coils of wire revolving between

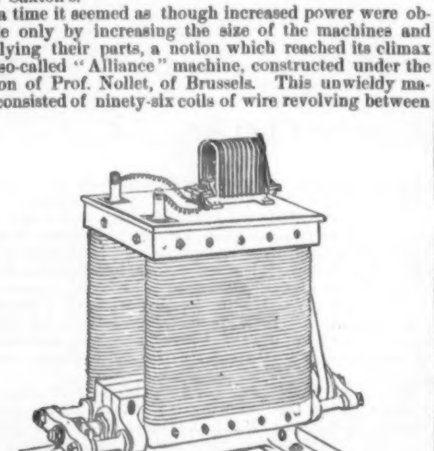


Fig. 2.—WILDE'S MACHINE, WITH SIEMEN'S ARMATURE.

the poles of fifty-six permanent magnets by steam power at the rate of 300 revolutions per minute. The electric light produced in this way is equal to about 500 candles. This machine is in use in the Hève Lighthouse, Cape Gris-Nez, near Calais, while several English lighthouses are supplied with Holmes' machine, in which the order is once more reversed, and the magnets are revolved before the coils.

In 1854, Siemens and Halske came to the rescue with an important invention, known as the Siemens armature. Instead of having a bobbin of wire surrounding a short core of soft iron, they argued that a much more powerful effect could be obtained by cutting the magnetic field—the lines of force of a magnet having an increased polar surface—by means of a grooved rod wound longitudinally with insulated wire. It was also found that permanent magnets were inferior to electro-magnets in producing induced currents in

Fig. 4.

coils of wire, not only because they were less powerful, but because they were much more bulky. The invention of the Siemens armature made it possible to construct long and flat electro-magnets, and to revolve the wound rod between their poles, thus producing very compact and efficient instruments.

Wilde's machine, exhibited at Paris in 1867, combined these advantages. Its construction is shown in Fig. 2. For the purpose of charging the large electro-magnet between whose poles the Siemens armature revolves, a small permanent magnet is placed on top. This magnet induces a current in a small Siemens armature, from which it passes into the coil of the larger magnet, magnetizing its core, and enabling it in turn to produce an intense current in the large Siemens armature.

Another step in advance was made by Siemens and Wheatstone, who conceived the idea of omitting the small or exciting magnet, and causing the large magnet to charge itself. They reasoned that no iron is so pure as not to retain some residual magnetism when the machine comes to rest, and that this residual magnetism could be utilized to charge the coil with a feeble current which would induce another current in the armature that could be passed back again into the coil. Practically a small part of the induced current is thus returned to the large magnet to keep up its strength, while the rest is made to do useful work. Ladd's machine, also exhibited at Paris in 1867, is constructed on this principle.

An entirely new principle was introduced in 1871 by M. Gramme, a Paris furniture maker, whose invention, which has been described in these pages (Scientific American, December 6th, 1873, March 25th, 1876, *et al.*), consists essentially in an armature made of soft iron wire bent in the form of a *ring*, and wound with insulated wire in such a manner as to form a number of sections, each of which has a loop of wire left exposed to make connection during the revolution of this ring with a number of copper conductors, which

Fig. 3.—GRAMME MACHINE FOR THE LABORATORY.

in turn communicate with two metallic rubbers. Numerous modifications of this machine, adapted to special purposes, such as electro-plating, lecture-room experiments, electric illumination, have been constructed. A small Gramme machine, with Jamin magnet, shown in Fig. 3. Although opposed and ridiculed at first, these machines possess the remarkable merit of yielding a large amount of electricity with a small expenditure of money.

In this country Mr. Palmer, of Boston, Mr. Wallace, of Ansonia, Mr. Brush, of Cincinnati, Mr. Weston, of Newark, and Mr. Hochhausen, of New York, have all constructed machines excellent in their way and involving the general principles described, but on which we cannot dwell now for want of time. (A number of these machines were exhibited on the platform.) By their means it is now possible to produce a light of about 600 to 1,200 candles per horse power, and a wide field for practical application is consequently opened which did not exist when the electric light was more expensive.

The lecturer then exhibited an intense electric light, made by the use of one of Weston's machines, run by steam power in the basement. Before its brilliancy the gas lights assumed a sickly yellowish hue. To show how the electric light is produced, the room was darkened, and the image of the carbon points with the voltaic arch between was thrown upon the screen, and it was explained that its brilliancy was due to the intense incandescence of particles of carbon torn off by the current from one pole and conveyed to the other. The figure shows this by the indentation of one pole. A piece of silver inserted in the cup thus formed was instantly vaporized, and changed the color of the light to a magnificent green.

The illumination of large workshops, public buildings, factories, docks, places of amusement, gardens, and the like by electricity may undoubtedly be regarded as an accomplished fact, and it has been predicted that the electric light will soon replace other means of illumination, *e. g.*, gas, in our private houses. While we cannot predict what the future may bring, we can at least study the past history of electric illumination, and judge somewhat of future probabilities from past experiences.

The idea of dividing the powerful electric light so as to obtain numerous lights from a single machine is not a new one. At least twenty years ago it was not only thought of, but, just as to-day, it was supposed to have been accomplished. M. Jobart, a member of the French Academy, and consequently a man of scientific reputation, made the following statement to the Academy, February 27th, 1858:

"I hasten to announce to the Academy the important discovery of the division of an electric current for illuminating purposes. This current, from a single source, traverses as many wires as may be desired, and gives a series of lights ranging from a night lamp to a lighthouse lamp.

"The luminous arc between two carbons produces, as is well known, a very intense flickering and costly light. M. de Changy, who is a chemist, mechanician, and physicist, is thoroughly conversant with the latest discoveries, and has just solved the problem of dividing the electric light."

He then describes the production of a dozen lights from twelve Bunsen elements, but as the invention died a natural death, it is not necessary to repeat his description here. The strong impression made by it at the time may be appreciated by M. Jobart's conclusion:

"The above slight description will suffice to show to what a variety of applications this discovery can be put. The

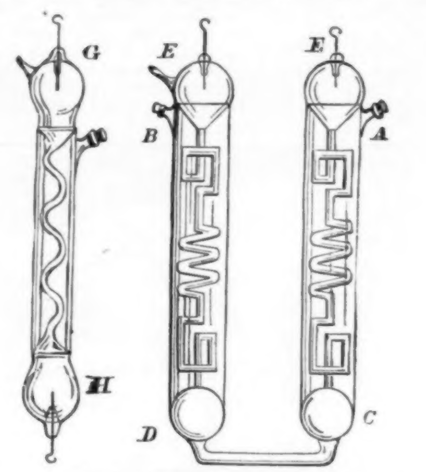


Fig 5.—GEISSLER TUBES.

communication I have had the honor of laying before the Academy is founded upon no illusion. A lamp was to my astonishment lit in the hollow of my hand, and remained lighted after I had put it in my pocket with my handkerchief over it."

Here we have, not a prediction, but a report of what was said to have been actually accomplished—a report fortified by the final test of the pocket, and that is more than many of the electric lights of to-day could stand.

Although the promising experiments of twenty years ago remained barren of practical results, we should by no means infer that success is impossible. It may be shown, on the contrary, that there are several lines of experiment which are promising to-day, though years may intervene before success is achieved.

In the first place, light of moderate intensity may be obtained by causing the electric current to heat platinum wire. An experiment before the audience illustrated this point, by showing the rather feeble light of an incandescent platinum wire, hardly sufficient to read by. The difficulty here is, that the wire is apt to melt unless the current is of only moderate intensity. The use of carbon points obviates this difficulty, but as they are rapidly consumed by the intensity of the heat, devices are needed to keep them at the proper distance apart, otherwise our lamp will go out the moment the distance becomes too great for the electric arch to span, and it will then be necessary to place the points in contact, and slowly to separate them again to the requisite distance. There is no time to enter into a description of the numerous "electric lamps," and their special devices for regulating the distance of the carbons. In Jablochkoff's candle this is effected by means of a septum of china clay between the carbons, the effect of which is, however, to increase the resistance considerably, and, therefore, to require more power. (A number of "electric lamps" were exhibited upon the platform.)

Hundreds of experiments have been made in this direction, and numerous patents have been granted in this country and in Europe, but the same difficulty affects them all—as soon as the light is subdivided the waste of energy increases so greatly that a current capable of supplying one lamp of say eighty candle power would scarcely suffice for two lamps of fifteen each.

In the next place, light is produced by an electric discharge in rarefied air and gases. This experiment was shown by means of Geissler tubes (see Fig. 5), in which advantage was taken of the different colors of the electric discharge in different gases to produce beautiful contrasts. In this connection may be mentioned the property of fluorescence, by which some bodies absorb luminous rays and emit them again with modified amplitude, so that some invisible rays of the spectrum are rendered visible. Perhaps fluorescent bodies, that is, such as retain absorbed light and continue to emit it some time after the source is withdrawn, might be utilized here.

The lecturer then exhibited a clock, the face of which had been painted with fluorescent material, and which continues to glow all night with the light absorbed during the day.

Still another means of obtaining light by electricity has just been made known by Professors Houston and Thomson of the Philadelphia Central High School. They propose to utilize what is known as the spark of the extra current by means of a very simple contrivance.

The electrodes are made of carbon placed at a convenient distance apart, and the negative one is then made to vibrate up and down by means of an automatic break-piece, so as to touch the positive one and then to recede again. A spark is formed each time, and if the vibration is sufficiently rapid the effect of continuous light is produced.

An apparatus had been hastily constructed at the Stevens Institute according to the description of the inventors, and a small bright light was obtained before the audience. It

looks as though something might be accomplished in this direction.

While the subject of electric illumination is thus receiving constant developments, we must not lose sight of improvements in existing means of illumination. A gas burner, said to give the light of about 250 candles, and consuming forty cubic feet of gas per hour, has just been received from Sugg, the famous London manufacturer, and also a smaller one of the same make. When the large burner was lighted before the audience the light was so intense that it was trying to the eyes to look at it. It appears from experiments made with these burners that the proportion of gas consumed in the large one is not nearly so great as for small ones.

The very rapid improvements in the electric light, and its actual introduction in large establishments, etc., have created no little excitement on the subject of its probable future. As an illustration, the lecturer alluded to a letter recently received from the head of a large educational institution, inquiring into the merits of the electric light, which he understood had been introduced in the Stevens Institute. He states that the directors would be glad to learn how far its introduction has met with approval, and *whether the existing pipes, burners, etc., could be utilized.* From what has been said it will be seen that such ideas are premature, and that we may not expect to see them realized in the near future.

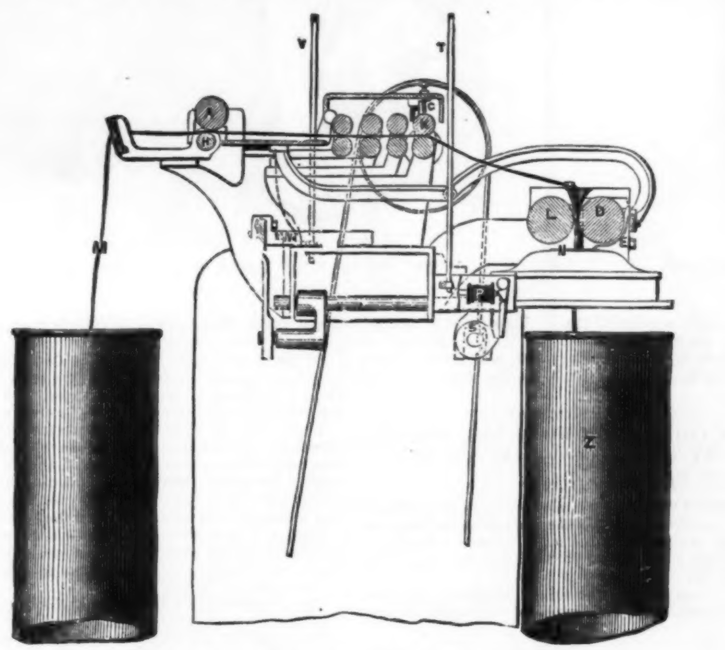
While the invention of Mr. Edison, about which so much has recently been said, is no doubt an ingenious solution of the problem of constructing a lamp capable of replacing a gas burner, and free from the most prominent objections that have hitherto vitiated such as were based on the heating of platinum wire, the difficulties of furnishing an economical and abundant general supply of electricity are yet to be overcome. The field of electric illumination is a vast one, but, so far as we can see now, it does not include what we may call the private illumination of dwelling-houses.

C. F. K.

THE ELECTRIC STOP MOTION.*

By W. H. BAILEY.

THE application of the invention to drawing frames will be seen by an inspection of this machine. The slivers, before they reach the drawing rollers, are made to pass between rollers which we may describe as electric rollers, the bottom one of which is fluted, and revolves in bearings attached to



THE ELECTRIC STOP MOTION.

the machine frame. The top rollers are made short, so as to allow of there being one for every pair of slivers which is passing through the frame, and they revolve in plates secured to a plate which is called a back plate, which is electrically insulated from the rest of the machine.

On the frame is a small electro magnet, and the stop motion and strap fork. The top series of electric rollers are kept from being in contact with the bottom one by means of a non-conducting cotton sliver, and the upper and lower rollers being insulated from each other by the non-conductors, the passage of the current is not possible; but supposing the sliver to break, the rollers come in contact, the circuit is completed, and the machine is stopped instantly. When the cotton laps on the drawing rollers, the stoppage is obtained as follows: These drawing rollers, both top and bottom, are in electrical contact with the machine frame, and, as is usual, are covered by the plates of the top clearers, which are placed at short distances from them, and are attached to the insulated back plate. The top clearers, therefore, are in electrical contact with one pole of the magneto-electric machine, and the drawing rollers in contact with the other. When the rollers work properly, the distance between the upper and lower rollers is of a well-defined character, but should the sliver lap over either top or bottom roller, the distance between the centers increases, which raises the top roller, and so comes in contact with the projection from the top clearer, and this produces electrical contact, stopping the machine as before. The calender rollers are insulated from each other by much the same simple means which I have just described. When the sliver is properly passing through, they are separated, no current passing, if, however, the sliver breaks in one of the funnels, then the rollers, having nothing to keep them apart, causes contact to result; the circuit then being complete, the operation becomes suspended, because the machine is stopped until the ends are pieced up. The last operation in connection with this ingenious mechanism, which I think appeals to us in consequence of its great simplicity, is when the front cans become full; when the required amount of sliver has accumulated in a can, the tube wheel is lifted up very slightly, which completes the circuit, and stops the machine as before.

We will now proceed to the roving or intermediate frame. Here it is requisite for the stop motion to act in two cases which are provided for the prevention of "single;" first, when the end breaks before it reaches the drawing rollers; and secondly, when a bobbin in the creel becomes empty. By them these causes of single are guarded against by the adoption of an "electric roller," round which the ends pass before they reach the drawing rollers. The breaking of an end or the finishing of a bobbin will cause electric connection to take place with this roller, and thus stop the machine.

* Read before the Scientific and Mechanical Society.

MUMMY HEAD AND EGYPTIAN ANTIQUITIES FROM THEBES.

"So Joseph died, being a hundred and ten years old; and they embalmed him, and he was put in a coffin in Egypt." This event, thus recorded in the Book of Genesis, happened sixteen hundred and thirty-five years before Christ, or, from the present day, three thousand five hundred and thirteen years.* The contemplation of this lapse of time strikes the mind with a great feeling of awe, and the human intellect staggers at its contemplation; yet it is possible that the head of the mummy which is now before me, steadfastly gazing at me with an expectant, mournful, yet pleasant smile, may be that of a human being, a contemporary of Joseph.

This magnificent specimen has been most kindly presented to me by my friend Mr. Douglas Murray, who, with other relics, brought it from the tombs of ancient Thebes. Thebes was the original metropolis of Egypt, and was in the height of its glory about sixteen hundred years before Christ. The ancient kings of Egypt lived here; the headquarters of the army were here; the sacred temples were here, in which the Egyptian priests performed the high ritual of worship to their gods, typical of the powers of nature, such as Ra (the sun), Amen Ra (the universal power), Neith (Minerva), Thoth (Mercury, the god of knowledge and reputed inventor of writing), Sothis (or the Dog Star), Osiris (the judge of the dead), his wife Isis, and their sons, Horus and Anubis; and here, too, it may be possible that Moses was instructed in the wisdom of the Egyptians by Harnetaft, the high priest, and by Tenamen, the incense-bearer, whose mummies are now in the British Museum.

This mummy head was brought from that wonderful Egyptian cemetery where begins, as it were, the City of the Dead, which, with its grand natural approach, has been so ably described by Mr. Douglas Murray himself in this journal of August 22, 1868, No. 135:

"In this magnificent gorge the rocks seemed at times almost to meet above our heads. Along the ancient causeway, and at each side of us, rose vast masses of sandstone, piled as if by the hands of giants in confused heaps of fantastic outline. At the end of the valley, and facing us, rose to a great height a pyramidal mound of extraordinary configuration, while occasionally a solitary eagle, circling far aloft in the sunny expanse of blue sky, made up a picture grander than anything Salvator Rosa in his most inspired moments ever transferred to canvas, and which might have been the original for one of Gustave Doré's gigantic and gloomy conceptions. Fit scenery, sufficiently weird, silent, and mysterious for the repose of Egypt's greatest dead.

"We presently found ourselves at the entrance to a staircase which evidently led deep into the heart of the mountain. Down these steps, after lighting our pine torches, we carefully descended until we reached a series of chambers, which, once tenanted by a king, has since been designated 'The Harpers' Tomb.' Situated at a short distance from Belzoni's, this wonderful underground palace is certainly next, also in point of interest, to that most celebrated of all great sepulchers. The name is derived from the fact that in a compartment of the tomb are represented two minstrels playing harps, built in exactly the same shape as our model 'Erards,' which are ornamented with gilding, and surmounted each with the head of a sphinx. One of them has as many as thirteen strings; and this sufficiently proves that the ancient people were highly advanced in the cultivation of music, in that respect differing widely from the modern Arabs, whose songs, though very quaint and often pretty, are all of them in the minor key. This minor key, the language of nature, seems a necessary accompaniment to the music of every uneducated and semi-barbarous people. In the compartment which contains the harps and harpers are, scattered in groups, many musical instruments, of highly finished workmanship and elegant design, while through the corridors and side chambers are pictures of rich furniture—sofas with crimson seats and gilt supports in the form of lions' feet, spears, shields, daggers, armlets, and the varied accouterments of a warrior.

"Leaving this vault, with the history of its date legibly impressed upon its walls, we descended again, by stairs and shafts let into the midst of the sandstone ridge, to several of the royal vaults, all fresh and bright under the red glare from our torches, but we had still to reach the mummy pits, where one may walk through rows of those dark brown Egyptians, swathed in their fine linen cloths, and redolent of the spices wherewith they were embalmed—sight and smell, no doubt, wholesome and salutary to a Capuchin monk, but unpleasantly suggestive to most mortals. The vast charnel house into which we now descended was crawling with antiquities and alive with bats. A shot from a saloon pistol caused the death of seven of these perverse dispositioned cheiroptera, who beat their ill-omened wings in our faces, clung to the brims of our wide-awake hats, and were slaughtered by swarms in a general 'battue.' This, one of the great tombs of the *Assaseef*, was covered far underground with sculptures in relief. We were lowered by ropes into chambers beneath, still sculptured, until at length, heartily tired of bats and bad air, we returned once more to the light of heaven.

"In a rock cavern, where candles burnt blue in the stifling heat, we succeeded in tackling an Egyptian lady, who was carefully brought to light and solemnly unswathed. Her chignon of curly black hair, together with a foot of remarkably high instep, are still to be seen in the cabinet of a collector. In this tomb we found a few blue porcelain figures of mummies represented in the character of Osiris, their great judge and god of the dead, with flail and scepter, the symbols of retribution and power. As we retreated with our female mummy attached to a cord, a large portion of the roof fell in—for the tomb was simply rough hewn in the rock—and the sand, closing in on the mouth of the cave, all but barred our exit, and would probably effectually shut the entrance to future travelers who might wish for a specimen of early embalming. The Arabs in the neighborhood have so little respect for their ancestors that they are in the habit of using them as firewood. The cloth, soaked in bitumen, burns very readily, and the body gives out a good flame, which is found useful for cooking, when there happens to be anything to cook. This great custom of the modern Thebans puts the funeral institutions of the Romans completely into the shade, for although the Romans burnt their dead, they never thought of turning them to any account for culinary purposes."

Again, on Belzoni's tomb, which is perhaps the noblest of all, we find the best and richest coloring. "The four square pillars of the first hall beyond the pit are decorated like the whole of the walls. On them are painted female figures, nobly proportioned, and of great beauty. Their robes of blue, purple, and scarlet colors, fastened with gold clasps, are magnificently embroidered with ornaments, and their heads crowned with elaborate tiaras of enameled work. In this chamber Horus, son of Osiris, the deity of good, is seen crushing beneath his feet, and stabbing with a spear, the giant serpent of evil, Aphophis, with his numberless folds and human head, proving to one's mind how widely spread are all the numerous primitive traditions."

The head of this mummy is probably that of one of the ancient aristocracy of Thebes. I judge so from the evident care which has been taken in its preparation. From the general contour of the head, I have come to the conclusion that it is that of a female. The forehead is somewhat receding and narrow; face rather projecting, of pure Egyptian type, viz., head small, low, and narrow. The actual features cannot be seen, as they are covered, as it were, with a mask. Linen bandages are placed round the neck like an old-fashioned white neckcloth. These are then brought up from the back of the head in a figure-of-eight fashion, and are made to envelop the whole of the back of the head. This is the work of a very clever artificer. The bandages are made of linen of about the same substance as those now used at St. George's Hospital. Underneath this linen mask can be plainly seen the outlines of the face; the pupils of the eyes are marked in with a black spot, and the eyelashes (also marked in) are united together at the external part of the eyes, the lines being prolonged on to the cheeks. The eyebrows unite over the bridge of the nose, and follow the contour of the prolonged eyelashes below.

About an inch above the eyelashes we see a narrow cord, or band of linen—a sort of fillet which, starting at the back of the neck, is brought up in a graceful curve over the ears, and again to the back of the head.

This mummy, I am delighted to say, wears a wig. We found the whole head covered with what at first sight appeared to be rolls of hair, but which, on examination, turned out to be imitation hair formed of little curl-like rolls of a material which looks like fine canvas. The rows forming this wig are arranged in three tiers, one above the other, and gracefully overlapping each other. The lowest tier begins from the top of the ear and runs almost straight across the forehead. It is not at all unlike the fashion of hair as worn by some ladies of the present day. To try the effect I have put a modern smartly-trimmed hat on the head of this Egyptian lady. I see that the fringe of hair is the same as the fringe of the present time. On the whole, there is a little more *chic* about it. The tips of the ears and the lips are covered with a dark red pigment, which I find is soluble, and comes off with the finger even after the lapse of so many thousand years. Another idea. I have washed a side of the mummy's face with warm water and a sponge, and, having again put on the smart Regent Street bonnet, am more convinced than ever that this is the head of a lady. The damping of the linen cloth has given quite a different and almost lifelike appearance to the features; altogether the lady looks very good-natured and smiling.

This application of moisture brings out the fact that the red material is not only on the ears, but also at the corner of each eyelid and on the nose. I cannot make out what has become of the lady's hair. I therefore dissected off some of the bandages of the back of the head, and then identified the bitumen which surrounds the skull. In this I find several little short hairs. I therefore consider that the head was shaved in order that the wig might fit the contour of the head gracefully, which it certainly does. Wigs appear to have been commonly worn by the Egyptians. In the British Museum there is a most splendid wig. Also in another case articles of dress and appliances for the toilet, such as a leather dress, a linen shirt, and a box to hold clothes, combs, hair-pins, ointment vases, and apparatus for painting the eyes with stibium, bronze mirrors, and a collection of shoes and sandals.

* This date is taken from "Cassell's Bible," where there is a capital engraving of the body of Joseph about to be placed in a mummy case.

I cannot find any marks of gold about this Theban lady's head. It appears, however, not to have been an uncommon practice to gild the nails of the fingers and toes of female mummies. I have in my collection the foot of a mummy, on the sole of which there are very substantial traces of gold. It may interest our readers to know the names of Egyptian ladies which I have picked out from various sources. They are as follows: Bochoris, Catbti, Tphous, Shepshet. I wonder what was the name of the lady whose head I now possess?

The word mummy is derived from an Arabic word, Mum, signifying wax. Herodotus, a very great observer, and evidently a great note-taker, has been good enough to record many interesting details relative to the process of embalming as carried out by the Egyptians. It appears that there were professional embalmers, whom the relatives of the deceased consulted as to the style of mummy. "They show the bearers of it wooden models of bodies painted in imitation of reality. They say that the most expensive of them is His, whose name I will not in such case mention. They exhibit also a second model, inferior to the first, and cheaper than it; and a third, the cheapest of all. After this explanation, they ask the bearers of the dead body after which model they wish it to be prepared, and they, having agreed upon the price, depart." "His" implies Osiris, who was the Jehovah, the great God of the Egyptians. This name was held in the highest awe.

Herodotus then gives us the prescriptions used in the different kinds of mummy making. In the most expensive process, powdered myrrh and cassia were used. The body then was pickled in a solution of natrum (carbonate of soda) for seventy days. In mummy making, Jew's pitch, or *Bitumen Judaicum*, was used. This is nothing more or less than the asphalt now used in making the London pavements.

The bandages appear to have been always linen, several feet long, differing, however, in the fineness of texture.

On reverting to the head since it has been wetted, I find that what appeared to be bandages over the face, are not so, but simply a linen mask in one continuous piece. This mask has evidently been applied wet to the face, and has been pressed down into the depressions of the features, so that the likeness of the person is apparent. I find also that the nose is considerably depressed on the right-hand side. This is a curious phenomenon, for which I cannot account, but in relation with it must be considered a fact that on the left side the head is covered with sand of a reddish color. This may be the sand of the desert.

One of the most perfect mummies I know of is a very old friend of mine. It is that of Horseisi, an incense-bearing priest of Ammon. He is now at the Royal College of Surgeons, Lincoln's-inn Fields.

"Mr. Pettigrew informs us that Mr. Clift, the intelligent conservator of the museum, suspected that there had been a fracture; and upon removing a portion of the skull this was found to have been the case. The occipital bone had been broken, and on the inner surface an exudation, or rather deposition of bone, extending upward of one inch in length, was found to have taken place, thereby marking the process of nature in repairing an injury of the frame."

Besides the head of this Theban lady, Mr. Douglas Murray has given me a mummy crocodile. The sacred animals of the Egyptians were as follows: Cats, jackals, cynocephali, bulls, rams, ibis, snakes, fish, crocodiles. They seem to have had special veneration for the crocodile. The reason for this, as suggested by Mr. Douglas Murray, is obvious. Crocodiles must have water to exist. Water in Egypt is of the highest importance for drinking and watering fields. If the canals were neglected the crocodiles would die. The people therefore were kept in order under a superstitious awe for the crocodiles, but it really was an artful dodge of the authorities to keep the water supply of the country in good order. The crocodile is about 22 inches in length. The right fore paw is placed over the right eye; the left fore paw is tucked under the chest. There is an appearance on the lower jaw as though it had at one time been slightly covered with gold. This crocodile was carefully wrapped up in linen cloth. My friend, Mr. Fred. Wiseman, the well-known yachtsman, discovered in the linen bandage which surrounded the crocodile's tail a knot used every day at the present-time by yachtsmen. Another interesting specimen found in a mummy tomb is a portion about two inches square of some substance which looks like amber. It is not, however, amber; its real nature is unknown. My own idea is that it is adipocere, a substance into which human bodies are not unfrequently converted, as I know so well from the discoveries I made when searching for the body of John Hunter in the vaults of St. Martin's-in-the-Fields.

Among the relics brought me from Egypt at the same time with the mummy head are various specimens of old pottery from Dendera and the Temple of Komombo; a very beautiful alabaster pot from one of the tombs at Thebes; also a very curious natural formation in flint from the mountains which flank the Nile. Two portions of papyrus plants were also in the parcel. From the word papyrus our English paper is certainly derived. The papyrus used to be made from the stalk, which was divided longitudinally into long thin flakes. These were placed side by side, and others put across them to strengthen and unite the papyrus. There are also numerous specimens of Nile fish collected at the same time with these other Egyptian curiosities. Among these are some heads of the large siluris and the head of a fish with some most wonderful lancet-shaped teeth. I cannot sufficiently thank Mr. and Mrs. Douglas Murray for bringing me home these interesting relics, which form a very valuable addition to my collection.—FRANK BUCKLAND, *in Land and Water.*

FIG 1.—MUMMY OF A CHILD FROM PERU, IN ITS WRAPPINGS.

FIG. 2.—MUMMY OF A MAN FROM PERU.

NOTES ON A COLLECTION FROM THE ANCIENT CEMETERY AT THE BAY OF CHACOTA, PERU.*

By JOHN H. BLAKE.

IN 1836 the writer visited and made a careful examination of the ancient cemetery in Southern Peru, situated near the shore of the Bay of Chacota, about a mile and a half in a southerly direction from the town of Arica, in lat. 18° 30' S., long. 70° 13' W.

The cemetery is on a plain, the soil of which is composed of fine silicious sand, marl, and gypsum, impregnated with

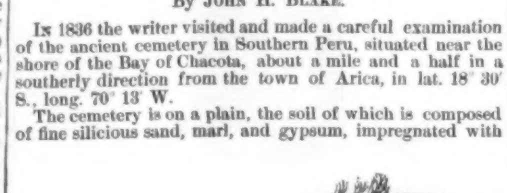


FIG. 3.—CAP FROM MUMMY.

common salt and nitrate and sulphate of soda. The graves and tombs occupy a large extent of ground, in two distinct places, about an eighth of a mile apart. They are marked in some instances by small circular mounds made up of pebbles and shells, or by circles of rounded stones laid loosely on the surface; but, for the most part, only by slight depressions in the soil over them. They all bear marks of fires having been kindled over them, as shown by the fragments of wood, coal, and ashes on the surface and within the interstices of the piles. In form they are all circular, but vary in size from three to five feet in diameter, and from four to five feet in depth. Some of them are walled with water-worn stones, laid up loosely, and all have linings of coarse flag mats.

At the time referred to, it was found that a great number of the graves had been opened and despoiled of their contents, probably in search of the precious metals occasionally found in them. Numerous skulls and other human bones, associated with fragments of pottery, were scattered over the surface of the ground. Many graves, however, remained intact, and a number of these were carefully opened and their contents examined. These in some respects were very similar, but in details there was found a wide difference. All the bodies, excepting those of infants, were in a sitting posture, with the knees elevated and the arms crossed over the breast, and generally seated upon flat stones, under which were placed many of the articles interred with them. They were closely wrapped in woolen garments, and the outward edges of the folds were sewed together with yarn, and in every instance the thorn needles, used for this purpose, were found thrust through the enveloping garments, often with pieces of yarn remaining in the eyes.

Of the larger part of these bodies little more than the skeletons remain. Some appear to have been subjected to careful desiccation, while others, the flesh of which is permeated with resinous substances, are well preserved.

There are no traditions connected with this particular cemetery, or similar ones in this neighborhood, and the present inhabitants of the country, of Indian origin, evince no respect for them, although not wanting in those sentiments which lead them to view with horror the desecration of the last resting places of those whom they consider their kindred.

Figs. 1, 2, and 8 represent three mummies from one of the tombs, or walled graves, referred to, selected from among those which were evidently intact and in the best state of preservation.

Fig. 1 represents a body from which none of the coverings have been removed, and presents the appearance of all of those which are in a good state of preservation. It is closely wrapped in woolen garments, outside of which, around the head, is wound a thread, having attached to it small feathers of various colors. The inclined position, toward one side, of the head and legs, is doubtless due to the pressure of the superincumbent sandy soil upon the body while it was soft and flexible, there being no arch or other covering to bear the weight or prevent the soil from filling the tomb, except the reeds and mats laid over the bodies within it. It is evidently the body of a young person, probably not more than twelve or fourteen years of age.

Fig. 2 represents the body of a man from which a part of the garments belonging to it have been removed, exposing to view the head, part of the breast, and one hand. With the exception of a part of the integuments of the lower jaw, the body is in a good state of preservation. The flesh is soft, of a dark brown color, and has a strong and peculiar odor which pervades the clothing, and is plainly perceptible throughout the whole cemetery. The head is of the rounded form (brachycephalic), with a somewhat retreating forehead; the cheek bones are high, and the nose prominent. The hair is long, of a brown color and of the ordinary fineness of that of Europeans. It is neatly arranged and braided; that on the front part of the head having been carried backward and formed into two rolls, one on each side, and that on the back part into a triangular plait made up of six braids.

The following are measurements of parts of the body which were accessible:

Length of the ulna, 10 inches; of tibia, 16·5 inches; of hand, 7·5 inches; of middle finger, 4·5 inches. The breadth of the part of the hand formed by the metacarpal bones is only 2·5 inches.

The outer covering of this body is a woolen garment of a brown color and comparatively fine texture, and a hood of similar material, with black, brown, and yellow stripes, was drawn over the head, the edges in front stitched together, and, at the bottom, to the other garment. Over this was a cap, Fig. 3, also of woolen threads, of various colors, closely and ingeniously woven, surmounted with a tuft, Fig. 4, made up of twelve small bunches of feathers, and in front an ornament formed of quills of the condor. Around the cap was a woolen cord about eight feet long, the outer part of black and yellow threads neatly woven around a central core. A smaller cord made of hair, attached to its lower

* From the Eleventh Annual Report of the Peabody Museum of Archæology and Ethnology, Cambridge, Mass., where the specimens figured and referred to are on exhibition.

edge, served to keep it in place when tied under the chin, as shown by the bow-knot connecting the ends. There was also around the cap a thread with small feathers of different colors, and a single flint arrow-head attached to it as shown in Fig. 3.

Secured to the back by a hair cord, and also by stitches to the outer covering, was a quiver containing five arrows. The heads are of stone, and the shafts, which are in two parts, are about two feet long; one of these arrows is represented in Fig. 5.

Suspended by a flat belt, passed over the shoulder on one side, was a bag containing leaves of coca (*Erythroxylon coca*) and a thin silver medal. The belt, or band, by which the bag was secured, is woven and of fine yarn in handsome black, white, and brown figures, with a border of red on one side and brown on the other; it is two and a half feet long and over an inch wide. The bag, measuring seven by eight inches, is very handsomely and evenly woven of fine yarn, in black, white, and brown stripes, and the edges are very curiously and tastefully sewed together with red, yellow, blue, and white thread.

The silver medal, or ornament, Fig. 6, found in the bag, is three and a half inches in diameter. A space in the center, three-fourths of an inch in diameter, is countersunk on one side, and in the center of this there is a small, round hole; there are also indentations on one side, all around, near the edge. A triangular piece about three-eighths of an inch long is wanting to render the circle complete, but this may have been broken off accidentally. The medal is very thin and brittle from oxidation. A hair cord, about two feet long, is attached to it, by which it may have been suspended from the neck.

Upon removing the cap and hood there was found, beneath the chin, a small earthen vessel, Fig. 7, about two inches in diameter, the top of which had been closed by a membrane, part of which, with the string which fastened it around the neck, still remains attached. It is not improbable that this cup contained originally a liquid, and this may account for the condition in which part of the lower jaw, before mentioned, was found, and it may, perhaps, also account for the oxidation of the silver medal. Such a liquid would most likely be *Chicha*, an acid drink, prepared by fermenting roasted maize, which has been known from time immemorial in Peru.

Fig. 8 represents the body of a female, from which all the wrappings have been removed. The fleshy parts, of a dark brown color, are soft, and the joints slightly flexible. For its preservation the same means evidently were used as for the preservation of the body which has just been described. The following are measurements of parts of the skeleton:

Length of humerus, 9 inches; of ulna, 8 inches; of hand, 5·5 inches; of middle finger, 3·5 inches; of femur, 13 inches; of tibia, 12 inches; of foot, 7·7 inches.

The breadth of the hand in the widest part is only 2 inches, and that of the foot only two and a half inches.

From the ankles to the knees the legs are coated with red paint, and there are marks of the same pigment on the hair of the head. The head resembles in form that of the body last mentioned. The hair upon it is fine, of a light brown color, and, when first exposed, was smooth and neatly arranged in braids passed across the upper part of the forehead, then carried backward and secured on each side of the head above the ears. It is somewhat coarser and much shorter than the hair on the head of the man. This body, like the one represented in Fig. 1, when first found, was closely wrapped in woolen garments. On the outside a cord was passed several times around it, and one also between the outer covering and that nearest within it.

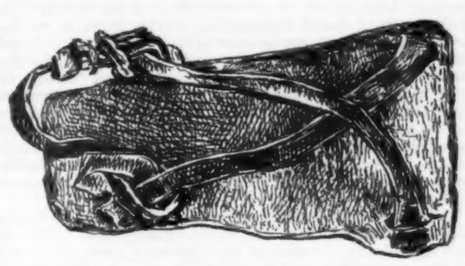


FIG. 9.—SANDAL FROM MUMMY OF AN INFANT. (Natural Size.)

Upon removing the outer covering there were found beneath it the following articles: A wooden comb, much worn, with hair adhering to the teeth; a pair of sandals, about 5½ inches long and 2 inches broad, painted red; three needles of thorn, about 3 inches long, tied together; two balls of yarn, one of them colored green and very tender, the other white and strong; a small package of shells, *Littorina Peruviana;* a bladder containing red pigment; a small package of *Rutile;* a bladder containing a gum resin, similar to that obtained by treating a part of the flesh of the body first described with water and afterward with alcohol; a pod from an *Algaroba* tree; two muscle shells, *Mytilus;* several locks of human hair, some of them rolled with leaves of coca.

On removal of the inner garment the body appeared, as shown in Fig. 8, with impressions of the cloth upon the flesh, particularly about the face.

In the same tomb there were the remains of an infant, carefully wrapped in a black woolen cloth, and inclosed in the skin of a penguin, with the feather side inward. Attached to the inner wrapper was a pair of sandals, Fig. 9, about 2½ inches in length. Between the wrappers were several small rolls of cotton, also rolls of hair of the vicuna with leaves of coca, two muscle shells, and several small shells of the kind before mentioned. The infant was dressed in a garment of brown cloth. The head was partly covered by a loose cap, lined with a wadding of cotton and hair covered with red paint. Within it was a large lock of soft human hair, on which the head rested; also, folded in a small piece of cloth, and tied with care, was a brown thread with seven knots in it, and on one end what appears like, and probably is, a part of the umbilical cord. Around the neck was a green cord with a small shell attached to it. Of this body, little more than the skeleton and the scalp, which is thickly covered with very fine dark brown hair, remain. The appearance of this and many similar bodies of infants found in this and other Peruvian cemeteries shows that no efforts were made for their preservation, at least no other than, perhaps, by desiccation.

A fœtal body, in its wrapper, was also found in this tomb, and it is particularly deserving of notice that, in many others, fœtuses were found preserved as carefully as the body of the infant just described.

(To be continued.)

FIG. 4.—FEATHER ORNAMENT FROM CAP.

FIG. 5.—ARROW FOUND WITH MUMMY.

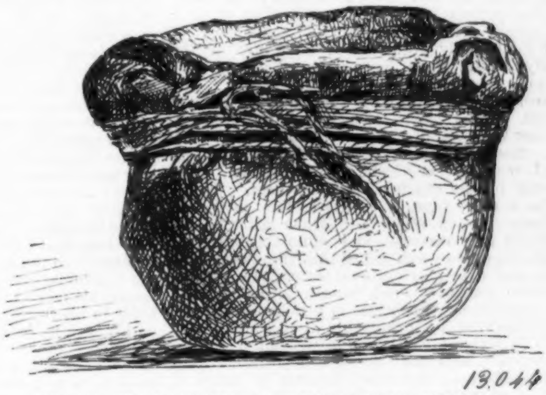


FIG. 7.—CLAY VESSEL FOUND WITH MUMMY.

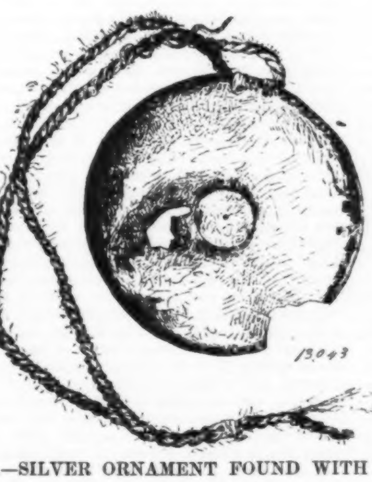


FIG. 6.—SILVER ORNAMENT FOUND WITH MUMMY.

FIG. 8.—MUMMY OF A WOMAN FROM PERU.

ANCIENT POTTERY FOUND IN MISSOURI MOUNDS.

By A. J. CONANT, A.M., ST. LOUIS.

THE number of vessels of pottery which have been taken from the mounds in Missouri is prodigious, and almost endless in variety. In an instance which fell under my own observation, nearly, if not quite, one thousand pieces were obtained from a single burial mound; and these were of various sizes and great diversity of form and workmanship. Some of the most characteristic examples will be presented as we proceed. The skill displayed by the prehistoric Americans in everything they manufactured from common clay is vastly superior to that of the ancient civilizations of Europe, to which, in other respects, many striking similarities may be traced.

From the fact that few articles which are the products of human ingenuity and skill are more enduring than earthenware, this class of antiquities, to the archæologist, is very interesting and instructive. The skill and taste displayed in its various imitative forms, in outline and decoration, give us an insight into some phases of domestic life, social condition and æsthetic taste of ancient peoples, which can be derived from no other source. Fragments of pottery to the archæologist, therefore, are the imperishable leaves of a book, inscribed by the truthful hand of humanity, in legible characters, with the precious records of those feelings and tender sentiments which are recorded nowhere else and which need no translation. Their value is enhanced so much the more by the fact that we possess specimens of these records from every quarter of the globe and coeval with the remotest civilizations.

The successful attempts of the ancient Americans to imitate the forms of beasts and birds, which they saw every

day around them, evince a contemplation, observation, and affectionate communion with nature which fill us with surprise.

In reference to the superiority of the skill displayed by the Mound-builders in the ceramic arts, to the corresponding civilization of ancient Europe, I cannot do better than quote the words of Dr Foster:*

"In the plastic arts, the Mound-builders attained a perfection far in advance of any samples which had been found characteristic of the Stone and even the Bronze Age of Europe. We can readily conceive that, in the absence of metallic vessels, pottery would be employed as a substitute, and the potter's art would be held in the highest esteem. From making useful forms, it would be natural to advance to the ornamental. Sir John Lubbock remarks that 'few of the British sepulchral urns, belonging to the ante-Roman times, have upon them any curved lines. Representations of animals and plants are almost entirely wanting.' They are even absent from all the articles belonging to the Bronze Age in Switzerland, and I might almost say in Western Europe generally, while ornaments of curved and spiral lines are eminently characteristic of this period. The ornamental ideas of the Stone Age, on the other hand, are confined, so far as we know, to compositions of straight lines, and the idea of a curve scarcely seems to have occurred to them. The most elegant ornament on their vases are impressions made by the finger nails, or by a cord wound around the soft clay.

"The commonest forms of the Mound builders' pottery represents kettles, cups, water-jugs, pipes, vases, etc., etc. Not content with plain surfaces, they frequently ornamented their surfaces with curved lines and fret-work. They even went farther, and moulded images of birds, quadrupeds, and of the human form. The clay, except for their ordinary kettles, where coarse gravel is often intermixed, is finely tempered, so that it did not warp or crack in baking—the utensils, when completed, having a yellowish or grayish tint."

In the vessels, while the human faces and heads of birds are crudely expressed, we find much to admire in the tasteful forms of the objects themselves. The flow of their outline, so to speak, evinces a degree of refinement of feeling which could only result from a culture of the sense for beauty, which must have required a long time for its realization.

The mouths or openings were, on all, made at the back side of the head. This seems to have been the uniform practice, whether the head of the vessel was that of man, beast, or bird. Sometimes the vessels with vertical openings are fitted with covers of the same material, with projecting knobs on the top for handling them. Sometimes, again, the smaller jugs, or bottles as they should be called, have nicely-adjusted stoppers. These latter bottles are made of much finer material, and while they are generally quite thin, they are so well baked that they seem to be almost as tough and strong as our own ware. Two of the stoppers are "two articles carved from a hard clay slate and carefully smoothed. Their use is problematical, but they so closely resemble lip ornaments as to suggest that they were such." These are now in the "Swallow Collection" of the Peabody museum. In its transportation from Missouri to Massachusetts, the report informs us, many of the articles were so broken as to make their reconstruction impossible. When I had the pleasure of examining this collection, some years since, these stoppers were then attached to the bottles with which they were found. The smaller bottle of the two, Professor Swallow informed me, when taken from the mound, contained a red liquid.

Some of the representations of the human figure are executed with a good degree of fidelity to nature, through all the members; showing that the artist had studied carefully his model, and had evidently labored to tell the truth as he saw it.

Some of the human figures have an expression so striking and individual that we can hardly believe that they are not portraits. This becomes more probable when we examine the animal representations, or rather the heads of birds, with which the pottery is very often ornamented, particularly those of the different varieties of ducks, in which we observe in the shape of the head, line of neck, etc., the nicest distinctions in particular varieties, which are expressed with remarkable skill. This will be apparent when we come to the consideration of food vessels.

Their imitative faculties, as illustrated in their pottery, were certainly remarkable, and to give an adequate idea of the variety of their work in the subjects which might be chosen for illustration would require more space than is allotted to this essay. We proceed, therefore, to consider their cooking utensils.

While these vessels were doubtless for common, every-day use, some of them are really quite artistic and graceful. The forms and ornamentation of the others seem to be more experimental, and perhaps transitional, as though the maker varied a little from his usual manner just to see how they would look.

All have two or more handles, by which they were probably suspended over the fire by passing through them green twigs, which they covered with moist clay to prevent them from burning. Examples might be multiplied, *ad infinitum*, almost, of this class of vessels, but the above is sufficient to illustrate the inventive powers of their authors in this direction, as well as their constant striving to gratify their æsthetic feeling in the manufacture of those fragile articles which were designed for the commonest uses.

One example represents a pot very similar to one of the latter, but entirely unique in this, that it contained the upper portion of a human skull and one vertebra. It was taken from a mound near New Madrid, by Prof. Swallow, who tells us that the vessel must have been moulded around the skull, as it could not be removed without breaking the pot. It is now in the Peabody Museum. This is certainly a curiosity. Nothing like it has been found in any other burial mound here or anywhere else, as far as known. It may be remembered, however, in this connection, as before remarked, that small pots have frequently been found in the larger pans, and which contained a decayed shell or fragment of bone. These were, very likely, valued relics or charms which were buried with their possessor.

One of the most common of varieties of bowls are peculiar in this: the bodies of the vessels are entirely devoid of ornamentation. From the edge of the lip on one side projects a small handle; on the opposite side is moulded the head of some beast or bird, and quite often a human head is represented.

The thing specially to be noticed is the diversity of form in the heads of the ducks. So faithfully are the distinctive features of the different varieties delineated, that those at all familiar with them must believe that the artist, according to the best of his skill, conscientiously copied nature. The beautiful curve of the neck, and its union with the outline of the vessel itself, could not possibly have been accidental.

The best which these ancient workmen could do is so far inferior to the art of our own times, that it is not easy for us to appreciate the difficulties they must have overcome, their many failures, the long time necessary for the acquisition of those habits of observation, and the development of the skill of hand sufficient to enable them to express themselves as creditably as they have done in all their imitative work. In the class of vessels under consideration, examples decorated with the human head and features are by no means rare. If the credit given them for conscientious observation of nature, and skill in expression of what they saw, is not an over-estimate, then we may believe that, in their delineation of the human face, they also copied nature with a sufficient degree of accuracy to warrant us in the idea that in their work we have at least characteristic likenesses of themselves.

The necessity for condensation demands that here our consideration of this part of our subject should end. The variety and beauty of many of the objects of their fictile skill are very suggestive, and furnish much material for extended generalization. But a remark or two must suffice in this connection. To suppose that all this taste and feeling—this close observation of nature and fidelity in delineation, displayed in the pottery of the Mound-builders, found no expression in any other direction, and was expended upon their domestic utensils alone, is simply incredible. Very different must have been the homes of a people furnished with such tasteful articles, from those miserable huts which the nomadic Indians constructed for their habitations; and it is quite likely that in their dress as well as their dwellings they evinced the same ideas of taste and convenience which we perceive in their domestic utensils. In some of their human effigies we do find the manner of arranging the hair distinctly delineated, and we may yet discover those which shall furnish us with correct representations of their mode of dress. Indeed, I have seen one vessel with figures of men rudely painted in outline upon its sides, who were clad in a flowing garment, gathered by a belt around the waist, and reaching to the knees. In this connection I may mention the engraved shells which have frequently been found with skeletons, both in Missouri and Illinois. One of the most interesting was furnished by the late Captain Whitley. When taken from the mound the shell was quite soft and brittle, and easily cut with the finger-nail. The outer edge was much broken or worn away. The design was inclosed by six circular lines, portions of which still remain. On one side were two perforations, designed, doubtless, for the string by which it was suspended from the neck. All similar shells that I have seen are so perforated. It seems quite evident from the picture that it memorializes the victory of the individual represented as standing over an enemy, who lies on his face at his feet. The victor, it will be observed, holds in his right hand a weapon or symbol of authority, with which he seems to be pressing the prostrate figure to the earth. Many of the accessories are unintelligible. While the whole work is very crude, and the figures out of all proportion, there is here and there an outline which shows earnest endeavor; as the leg of the standing figure, for example, in which also the action is so well expressed as to suggest that, by an impetuous onset, he has just felled his antagonist to the ground. The artist seems to have had most difficulty with the eye, or rather, has made no attempt at imitating that organ.

There is now in the museum of the St. Louis Academy of Science a similar shell, upon which is portrayed, in a creditable manner, the figure of a spider. I have also been shown another by Dr. Richardson, from a mound in Illinois, almost precisely like it, and differing only in a small symbolic device, which is carved upon the back of each. Engraved shells are generally found upon the breast of the skeleton, or in such a position as shows that they were originally placed there, and also where they were probably worn during life. According to Mr. Pidgeon, the spider emblem is perpetuated in the mounds far to the north. He describes one which he saw in Minnesota, about sixty miles above the junction of the St. Peter's river with the Mississippi, which covered nearly an acre of ground. Upon ascending its highest elevation, he tells us, it was very evident that the spider was intended to be represented by it. I bring these facts together for the benefit of future observers, without speculating as to their significance, further than to venture the remark that they point to a great diffusion of one people, or their migration from the north, southwardly along the Mississippi valley.—*Commonwealth of Missouri.*

* Prehistoric Races of the United States, p. 236.

THE BERLIN PAPER EXPOSITION OF 1878.

WE have seen the ordinary uses of paper, and now this last notice will deal of the novel appliances of paper, and the uses to which paper and paper stuff can be put. At various stands we meet the following articles: Masks, animals (models), a full-rigged ship, Chinese lanterns, hats, bonnets, skirts, suits of clothes, pocket handkerchiefs, *serviettes*, baths, buckets, wash-hand basins, water cans, straps, floor cloth, carpet, urns, bronzes, flowers, window blinds, curtains, asphalt roofing, garden walk material, coral (imitation), jewelry, and, finally, a house. These exhibits are made of paper. The only thing I missed was the new material for preventing the fouling of ships' bottoms. I have read that the bottoms of several ships have been coated with about one inch of specially prepared paper. The paper is cemented on, and preserves the ship very efficiently. This will develop a new trade, if it be so successful as reported.

The masks and animals alluded to above are made of papier mâché, and the latter are intended for the use of schools as models. They are very carefully and artistically prepared. There are, of course, innumerable Chinese lanterns, an old use for paper. The hats of paper stuff are very good. They are really a very clever imitation, and a stranger to the trade, and who does not critically examine his wearing apparel, might very easily wear one of the paper hats, and not have the remotest idea that his head was in a mass of pulp. The bonnets and frill work, made of lace paper, were also very fair specimens of skill. But I have seen better goods. The skirts and shirts, etc., of paper were excellent, but supposing the cook went too near the fire! The handkerchiefs were pretty fair, and I carried away the paper *serviette* which was laid for me every day at dinner in the Exhibition restaurant. It is nothing very particular; I think I have seen better elsewhere.

Messrs. Crane Bros., of Westfield, Mass., have a lot of articles in the water holding vessel line. Baths and buckets, looking exceedingly like metallic goods, are very fine specimens of skill. I should say they are about as perfect as it is possible to make them. Some belting shown by this enterprising firm deserves attention. I do not know how this paper belting wears, perhaps some one from your side will inform me. Leather belting is very expensive, indeed, and if paper is cheaper and as strong, there ought to be some business.

There is an excellent show of floor cloth, mainly by Seymour Scott Bros., of Philadelphia, who have perfected the production of this special variety of paper. I saw several models of houses whose roofs were made of the asphalt roofing paper. From the appearance of this paper, I should think it most excellent roofing material. It is thick and water tight. Whether with repeated wetting and drying and heat of the sun it will not warp, I can't say, but to all intents and purposes I don't see why it should not be largely employed. This same substance was used, too, as a pavement. The question of wear and tear will come in here; but in a garden where the traffic is not heavy, I think something could be done with it.

I noticed another American firm, the Celluloid Novelty Company, of New York, exhibiting very pretty little red ornaments and personal jewelry in celluloid. These articles looked very much like coral, an imitation of which I expect they really profess to be. From the attention this stand received, especially from the fair portion of the visitors, I should say this firm did a fair business at Berlin.

The *pièce de resistance*, however, was the paper house. The house itself was built of American pine. Then next to the wood came some building paper, followed by wall paper. The roof was our old friend the asphalt roof paper, and the ceiling, highly ornamented, was also of paper. Likewise was the cornice, a very handsome piece of work. The table, chairs, and general furniture were paper, dyed, and properly stained. The Venetian blinds and window curtains, both lace and colored, were also paper, as was the gas chandelier. Upon the table stood paper vases filled with paper flowers, which matched well with the paper table cover. The floor was papered with floor cloth, and a real paper stove was warming the room and astonishing the visitors by its non-consumption of itself. It was made of asbestos paper. Several very handsome bronzes adorned the room, but, on closely inspecting and lifting them, they also turned out to be paper. The door, a superbly-wrought piece of work, was paper, and several cupboards also. The house, as it stood, was bought by a gentleman to adorn his garden. A great deal of attention, and even excitement, was created by this house, which was put up, I believe, by Seymour Scott Bros., Philadelphia.

I must not omit to remark the pyramid of paper representing the consumption of paper by all the principal countries of the world. It is needless to add that America forms the base. At 494 the *Journal* was laid by your special commissioner on the table, where it was, of course, greatly admired, etc., by the throngs of visitors.

Now what can be gathered from the Berlin Exhibition? I venture to say that, so far as the ordinary use of paper is concerned, only one point is worthy of notice, and that is the wood fiber industry. Secondly, we can learn many uses for paper which have not, so far, obtained general notice and the popular eye. But it struck me that all the novelty of this feature of the exhibition is chiefly due to American enterprise. The paper house, the paper baths, urns, floor cloth, carpet paper, belting, jewelry, etc.—all American goods—proved how true it is that you are ever to the front. —*Paper Trade Journal.*

THE RICE PAPER OF CHINA.

THE present rage for art objects of Chinese and Japanese origin has probably made the public generally more familiar than ever before with those exquisitely colored representations of birds, insects, and flowers painted on what has always been familiarly known as "rice paper." These paintings, as well as the delicate, translucent material on which they are executed, were brought from China at an early period of our commerce with that country; and the material was evidently called rice paper for want of a better name, since it is not a paper, properly so-called, nor does any rice enter into its composition. It is, in fact, made by slicing the pith of a plant and pressing it into thin sheets; and if called "paper" at all, should be styled pith paper rather than rice paper. The tree which produces the pith is allied to our American wild sarsaparilla (*Aralia*), and was formerly called *Aralia papyrifera*, but is now known botanically as *Fatsia papyrifera*, the specific name being given in allusion to the use made of the pith. The tree, which rarely attains a height of more than 20 feet, is a native of the Province of Yunnan and the Island of Formosa, where it is called by the Chinese name of *tung tsao*. The flowers, which are small and greenish, are produced in numerous pendulous panicles, one to three feet long, at the end of the branches. The mature leaves, supported on long petioles, are round-heart-shaped, five to seven lobed, often a foot long, and soft and flaccid. The vigorous stems contain a snowy white pith, an inch and a half in diameter, for which the tree is sought after and cultivated. This pith forms an important item in the domestic trade of China, and is not only used in making the sheets which are familiar to us when decorated with paintings, but is also largely employed in the manufacture of toys and artificial flowers. The operation of making the pith paper is not unlike that of cutting corks; the pith, after being divested of its exterior covering of woody matter, is soaked in water, and pressed into a uniform cylinder by a machine; it is afterward placed on a frame, where it lies firmly, and the workman, by means of a long, thin, very sharp knife, pares the cylinder from the circumference toward the center, and along its entire length, into a sheet. The sheet thus produced is spread out and flattened under weights until dry, or pressed out by means of an iron; the little holes or other imperfections being neatly mended with bits of mica glued underneath. The greater part of the product is sent to be dyed of various colors for the use of manufacturers of artificial flowers. The largest and best sheets, about 10 inches wide by 15 long, are mostly selected for foreign markets, after being painted by artists in Canton or Hong Kong. The refuse is used for stuffing pillows, filling the soles of shoes, and for other purposes for which a light and dry material is needed. From the uncut cylinders of pith are made toys, insects, rude mosaic pictures, and various fancy articles. The pith is also exported to some extent in the stem for the use of artificial flower makers, who find in its tissue a material which more closely than any other imitates the petals of the most delicate flowers. Dr. S. W. Williams states that under foreign guidance the native workmen have greatly improved in their manufacture of artificial flowers, making them more natural, and producing large bouquets. Chinese women wear no bonnets or other head covering, but deck themselves with natural or artificial flowers to such a degree that a crowd on a gala day appears

very picturesque from the great variety of flowers seen in the women's hair. In some sections of the country, the condition of a woman, whether maiden, wife, or widow, may be distinguished by the style or color of the flowers she wears in her hair. "In Peking, a fair is held every morning in a certain street in the outer city, where the manufacturers of artificial flowers bring their wares, and the peddlers supply themselves for the day's traffic; and this exhibition of pith paper and silk flowers is one of the most beautiful sights in the city, stretching along the narrow streets for half a mile. It is a very fascinating sight to watch a workman in this craft, with an assortment of colored sheets of pith before him, a collection of pincers, knives, and pins, a pot of glue, and a few sizes of copper wire, imitate a dahlia, a lily, or an aster, as the fresh flower lies before him. His skill in cutting and shaping the petals and calyx, and fashioning the leaves, is only equaled by his accuracy of eye in choosing the color and modeling the flower." Foreigners in the East often wear pith hats as a protection from the sun, which were formerly made of alternate layers of bamboo and pith paper fastened to a rattan frame, and the whole covered with silk or cotton. The pith paper in these has now been superseded by a cheaper pith obtained from a species of rush (*juncus*), which also furnishes tapers for the water lamps used by the Chinese. The material used in India for making hats for Europeans, and called "Indian rice paper," is neither pith, rice, nor paper, but the light and spongy wood of a leguminous plant (*Æschynomene*) cut into thin paper-like slips; it is heavier than rush pith and much dearer in price.

ORIENTAL STYLE AS APPLIED TO FABRICS.

THE *Textile Manufacturer*, commenting on the present altered condition of affairs by which the British textile interest finds itself surrounded, when, face to face with an active and unhealthy competition at the hands of American and European manufacturers, it no longer enjoys that monopoly that it formerly did, indulges in the hope that England will again find a large outlet for her woven fabrics in the requirements of the vast populations of India and China and the peoples inhabiting the ancient seats of the Babylonian, Assyrian, Persian, and other past empires. As "no pent up Utica contracts the power" of our American manufacturers, they, too, will probably ere long be pushing the fruits of their looms into these same far-off regions. Our consuls, in their answers to the trade circular of the Government, have frequently called attention to the fact that our manufacturers of textile fabrics too often forget that their goods, in order to meet with a ready sale, must not only be of a character to fit them for the needs of the peoples to whom they are sent, but, what is equally important, they must also in *style* be adapted to please their tastes, between which and our own there is often a wide difference. The following remarks of the *Textile Manufacturer* bear on the latter subject. It says:

Betwixt Eastern and Western notions of taste there has ever been a wide breach. Whereas, in our later civilization, Western notions of both drawing and color appear throughout to have lacked those fixed principles necessary to the existence of art in its primitive truth, we have not to look long among the productions of the Asiatics before we discover a stern durability in those main principles which have guided their efforts since the mystic time of man's first abode on the earth. The oldest remains of ancient art, culled from the columns of Assyrian and Egyptian monuments, present us with that formality of design much of which we see in the best examples of later Oriental practice.

One of the earliest records of the textiles of the ancients is the rather full description of priestly garments and service cloths used by the Israelites in their worship, given toward the close of the Book of Exodus. The account of the massing together of the brightest colors is sufficient evidence to prove the unalterable conditions attending the use of color in certain climes.

To India perhaps belongs the credit of having developed and given a distinctive character to the art of weaving, though wherever these first principles may have originated is no part of our present task to decide. Their duration is what chiefly concerns us, and whether the submerged continent of Lemuria, Central Africa, or Asia was the birthplace of the art, it is all the same in the present day, at least so long as we forget not to profit by the splendid examples these ancients have handed down to us.

That Eastern designs possess a special distinctive character all their own, few will dare to question, and it is in a successful adaptation of their style to our English made goods that we must look for a future trade with India. The large business in cotton cloths which has been transacted between this country and the East ought to be sufficient inducement for us to try if other branches of our manufactures cannot be introduced or increased; in fact, force of circumstances, and our waning trade relationships, must inevitably compel us to seek "other fields and pastures new." In attempting to expand our exports in this direction we shall have to throw off the old notion that anything will sell at a price, and consequently glutting the markets with low priced and worthless stuff.

The idea that we are dealing with an artistic people imbued with a reverence for time honored modes, must be considered, and even the particular traditions and history of their art should be studied. Their method of applying colors is the first rule to be mastered. Turquoise blue, Levant green, and carmine red, worked together in flat bars like chevrons, are shown among their simplest efforts, the beauty here consisting merely of the nicety with which these colors are apportioned, their several parts being so arranged as to present a correct balance in the general appearance. No attempt at the pictorial effects of perspective and shading is attempted, the Orientals believing, and rightly so, that such features are completely out of place, or lost upon materials which are intended to drape or hang in folds that of themselves produce an infinite variety of beautiful curves. Besides that, the allegorical use of art is considered to be a higher aim than the mere facsimile representation or mechanical photographing of light and shade.

The ludicrous audacity with which the Chinese play with the rules of perspective, only to mischievously infringe them, is humorous in the extreme.

Their preference of the primary and secondary colors, and neglect of tertiaries, is another great characteristic in Eastern practice. And in this respect Oriental custom differs as widely as possible from that pursued by Western nations.

As the traveler goes westward he discovers, particularly among the Northern nations, an appreciation of tones and neutral tints, and these grouped together in shadings of different tertiary colors are made to produce patterns entirely devoid, in some instances, of the slightest life or brilliance. This, no doubt, is in perfect keeping with the climatic conditions of these countries, where the sun shines with diminished radiance, although considered by some to be a "false yet charming art." Nature herself, in clothing our woods and fields in quiet tones of green and russet, with an absence of the gorgeous display of orange and red so common in the East, dictates to us separate laws for different climates. Under a gray sky or a November fog, Oriental conditions are inapplicable, at least so far as color is concerned. And, as the antithesis to this, our Western notions of perspective, drawing, and coloring are as completely contrary to Indian or Chinese requirements.

Shading, or the gradual melting of one tone into another, is also at variance with Eastern habits.

Among the birds and animals represented in their woven fabrics, peacocks, birds of paradise, rats, antelopes, boars, deer, tigers, doves, etc., are all drawn in a stiff and formal manner, and done in one color only. Figures from the sublime to the ridiculous are in this manner depicted for the

No. 1.—CHINESE.

amusement and instruction of those who care to study them.

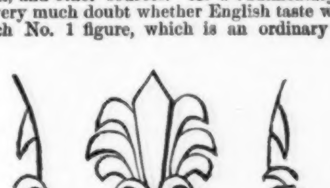
In flowers, the acanthus, lotus, honeysuckle, and others, are drawn merely as conventional ornaments, with the stems almost straight, and the leaves as severe and formal as possible. The fabrics shown in the Paris Exhibition by the Compagnie des Indes are (with a few exceptions, where magenta has been introduced) faultless in color. In the figured part of their shawls the idea of producing what, at a distance, looks like a neutralized bloom, is attained by the skillful massing of small quantities of the brightest colors, filled into patterns of almost interminable variety, the borders often being in self colors of the brightest hue.

In Japan, previous to the termination of the Shogoon's rule, scarfs were made and sold at prices ranging from ten to twenty shillings, which are now offered at a considerably

No. 2.—HINDOO.

less number of pence. This, we are told, is a result brought about by English and American merchants, but chiefly by the latter. And, perhaps, it is not so much a question of using lower material as of taking inferior workmanship.

But, whatever may be the tastes of Europeans and Americans (and we won't attempt to disparage them), there is no doubt that when we become more intimately acquainted with Eastern wants we shall find them to tend in quite an opposite direction to those of the West. Below we have appended as types a few of the simplest Chinese and Indian ornaments, obtained from the antiques belonging to H.R.H. the Prince of Wales, the Maharajah of Cashmere, the Imperial Customs of Shanghai, and other sources. As a rudimentary experiment, we very much doubt whether English taste would exactly match No. 1 figure, which is an ordinary border,

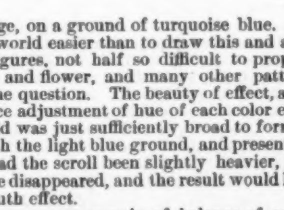


No. 3.—ASSYRIAN.

worked in orange, on a ground of turquoise blue. There is nothing in the world easier than to draw this and a hundred other similar figures, not half so difficult to proportion as the cone, knop, and flower, and many other patterns; but that is hardly the question. The beauty of effect, as we saw it, lay in the nice adjustment of hue of each color employed. The fillet of gold was just sufficiently broad to form a pleasing contrast with the light blue ground, and present a graceful pattern. Had the scroll been slightly heavier, all lightness would have disappeared, and the result would have been a clumsy, uncouth effect.

Contrast this, as a mere sample of balance of color, with our English embroidered table covers. To the ordinary mind, perhaps, these are small things, but a patient study of such details must be performed before we can proceed to more complicated questions.

In the violet of the ancients the cast decidedly inclines



No. 4.—EGYPTIAN.

toward blue, and the Tyrian purple is less of a purple than its name would indicate.

Among modern productions of Eastern goods the color known as solferino is not uncommon, and magenta, we regret to say, is only too often seen. The obtrusive vulgarity of this latter so completely destroys all repose, that the least impressionable observer can detect something wrong about it.

The colors, blue, purple, and scarlet, spoken of in the decoration of the tabernacle (Exodus xxv. 25-35), constitute a large part of the stock in trade of the Hindoo colorist. His art is traditional, reaching back to the fabled deities, Brahma, Siva, and Vishnu, the Creator, Destroyer, and Preserver. His genius, for these three thousands years slumbering amidst the relics of a sublime past, like the lamp of Aladdin, now lights the way toward the new treasures of a magnificent future. What cunning brain will read the sphinx-riddle, and open the way for our manufacture of the art fabrics of India? On the shoulders of what fortunate people is this mantle of inspiration to descend? We await the solution of this problem with intense and absorbing interest.

(Continued from SUPPLEMENT No. 149, page 2367.)

DETERIORATION OF OIL PAINTINGS.

OIL and fat are bodies consisting of carbon, hydrogen, and oxygen. They may be considered as salts in which glycerine, as a basis, is combined with different acids, stearic acid, palmic acid, oleic acid. If oil is exposed to the air it changes; certain kinds of oil remain liquid; others become thicker and darker, and are gradually transformed into hard and opaque bodies. The drying of oils is based upon a chemical process, during which the oil oxidizes by absorbing oxygen from the air, and combining a part of it with carbon to form carbonic acid, and another part with hydrogen to form water. The different oils dry with different rapidity, but this rapidity may be modified by the presence of certain substances, or by certain treatment. Linseed oil, for instance, according to the way in which it has been pressed out of the seed, contains more or less mucilaginous substances. These latter impede the drying of the oil, and have therefore to be removed by a refining process. If linseed oil in a shallow vessel is exposed to the air and light, especially to a green light, it soon begins to dry, and is transformed first into a kind of varnish and gradually into a solid opaque substance. The drying may be quickened by boiling, and more particularly by the addition of lead, zinc, or manganese. In this way a quick-drying oil varnished may be prepared and used as a siccative. It follows that there are certain substances which impede the drying of oils, and others which facilitate it. Among the pigments are some which belong to this category of bodies: white lead, zinc-white, minium, vermilion, for instance, facilitate the drying; others, such as ivory-black, bitumen, madder-lake, will impede it. Supposing now we should add to each of the different pigments the same quantity of oil, the drying of it would progress at different rates. But in reality this difference is very greatly increased by the fact that the different pigments require very different quantities of oil, in order to be ground to the consistency requisite for painting.

Pettenkofer quotes the following figures, given to him by one of the color manufacturers:

100 parts (weight)	White lead	require	12	parts of oil.
" "	Zinc-white	"	14	"
" "	Green chrome	"	15	"
" "	Chrome yellow	"	19	"
" "	Vermilion	"	25	"
" "	Light red	"	31	"
" "	Madder-lake	"	62	"
" "	Yellow ocher	"	66	"
" "	Light ocher	"	72	"
" "	Camel's brown	"	75	"
" "	Brown manganese	"	87	"
" "	Terre verte	"	100	"
" "	Parisian blue	"	106	"
" "	Burnt terre verte	"	112	"
" "	Berlin blue	"	112	"
" "	Ivory black	"	112	"
" "	Cobalt	"	125	"
" "	Florentine brown	"	150	"
" "	Burnt terra sienna	"	181	"
" "	Raw terra sienna	"	240	"

According to this table a hundred parts of the quick drying white lead are ground with twelve parts of oil, and on the other hand, the slow drying ivory black requires one hundred and twelve parts of oil.

It is very important that artists should have an exact knowledge of these matters. But it seems to me that they are insufficiently known to most of them. All, of course, know perfectly how different the drying quality of different colors is. But that these different colors introduce into the picture so different a quantity of oil, and how large this quantity is in the colors they buy, and further, that the oil as well as the mediums or siccatives they add to dry the colors are gradually transformed into a caoutchouc-like opaque substance, which envelops and darkens the pigments; and moreover, that the oil undergoes—not in the beginning, but much later on when it is already completely dry—changes of volume, and so impairs the continuity of the picture—all this is not sufficiently known. Otherwise, the custom of painting with the ordinary oil colors to be bought at any colorman's, would not have been going on for nearly a hundred years in spite of all the clearly shown evil results; results due, chiefly, to the principal enemy of oil painting, that is to say, the oil.

That the masters of the fifteenth and sixteenth centuries did not use colors prepared in this way, you may consider as absolutely certain; and if we hear the lost secret spoken of, and if we read that the pupils of the old masters had to pledge themselves to keep the secret, we may be sure that it is neither the method of painting nor the pigments used for it which is concerned in that secret, but exclusively the way of preparing the colors. The preparation was a very complicated one, varying with the different pigments; and we know that the pupils passed six years, that is half of the apprenticeship, in grinding the colors for the master.

And, therefore, it is to this very point that every one who wishes to study the method of the old masters must first of all direct his attention. I, too, was led, by the study of this question, to analyze and restore old pictures. The possibility of making such analysis we owe to the relation between the old masters and their pupils. Of course we could not dissect or chemically analyze works of Titian or Raphael. But fortunately the pupils painted with the same material and by the same method as the masters, and thousands of pictures by the pupils, well preserved or in different stages of decay, may be easily procured.

I have myself, from among a very great number of such pictures, selected about one hundred specimens, part of which I have brought before you. As their artistic value is not, as you perceive, of the highest description, we need not feel any scruple in experimenting upon or even destroying them, if we can thereby gain any valuable information.

If we compare the pictures of the Italian and Dutch schools of the fifteenth, sixteenth, and seventeenth centuries, with those of the French and English schools of the last hundred years, we are struck by the great difference in the nature of their diseases. We may divide those diseases into constitutional ones—that is to say, such as are based on the method and the material used for painting, and into those produced by external influences.

The Dutch pictures of the fifteenth, sixteenth, and seventeenth centuries, and the Italian pictures of the fifteenth

and sixteenth centuries, seem to me perfectly free from constitutional diseases. It is only in the seventeenth century that the Italian pictures show a special constitutional alteration, caused by the practice of the Bologna school.

The pictures of the last hundred years of the French school, of a part of the English school, and some painters of other schools, have been attacked by a constitutional disease perfectly defined and characteristic of this period.

Among external influences injurious to oil painting, we have to consider dampness, heat, bad air, dust, smoke, mechanical injuries, and last, not least, the destructive, or "altering" hand of the picture restorer.

Pettenkofer's scientific researches first clearly defined the influence of humidity on oil paintings, showing that it produced a discontinuity of the molecules of the vehicle and the resinous substances. As glass, when pulverized and thereby mixed with air, loses its transparency, and water, when mixed with oil, becomes of a milky aspect, so the oily and resinous substances contained in paintings will become dim as soon as the air penetrates between their particles. The picture thus assumes a grayish dim appearance, and the pigments seem to have been fading. That this is not really the case has been proved by the influence of a process invented by Pettenkofer, which he calls regeneration. In a flat box the picture is exposed to air impregnated with alcohol. Of this latter, the resinous elements of the picture absorb a certain quantity, swell and fill up the interstices between the separated particles so as to reunite them into an optically homogeneous, transparent substance.

The alcohol does not affect in the same way the hardened oil. If the interstices between its particles are not filled up by the swelling resin, it becomes necessary to introduce a new substance into the picture, and this is called nourishing a picture.

Pettenkofer has the great merit of having clearly proved that the nourishing of a picture with oils, as the custom was formerly, and still is to some degree, is a very objectionable proceeding, as it has the effect of darkening the colors forever. He recommends, instead of oil, balsam of copaiba, which has become since an invaluable means for preserving and restoring oil paintings, and will be more and more extensively used.

I have frequently applied Pettenkofer's method, and with very beneficial effect; but whenever I mentioned it to professional picture restorers, here as well as on the Continent, I always found them to reject it, either *a priori*, or after experiments incorrectly made.

In Munich, it seems, the pictures of all periods and of all schools have had to suffer under local influences and through the changes in the humidity of the air. This accounts for Pettenkofer having principally described this, so to say, endemical disease. In other galleries this affection does not appear so frequently, and Pettenkofer's method, therefore, will not find everywhere the same extensive application as at Munich. I think, however, that with some modifications it may be employed against some other alterations. I have, for instance, found it efficacious with paintings which had been injured by exposure to great heat. I shall show you a small picture which had been hanging for a long time so near a gas flame that it was almost completely scaling off, and so entirely faded that it scarcely looked like an oil painting at all. In that state it was exposed to alcoholized air, then nourished with balsam, and its back slightly varnished; and the scales starting from the canvas were refixed by pressure. And now it appears fresh in color, firm in substance, and perfectly smooth on its surface. The old, cracked varnish, melted together by the alcohol, looks as if fresh laid on.

Humidity sometimes favors the development of fungus. The round, black, small spots which pass through the canvas and the painting of these two pictures are produced by the same little plant which Professor Tyndall showed you when he spoke on the highly interesting subject of spontaneous generation.

Oil and water, so injurious to oil paintings, enter both into the material used for lining. Anxious to exclude these sources of danger, and to simplify the whole process, I have endeavored to replace it by a new method which I shall submit to you this evening.

How paintings may be disfigured by restorers you see in this picture, which was renovated with oil colors according to the practice only abandoned about thirty years ago, when it was advantageously replaced by the use of varnish colors.

The amount of external injury oil paintings sometimes endure and stand is perfectly amazing. Pictures in the course of centuries, during the destructive fury of wars and revolutions, may have been torn out of their frames, rescued from below the ruins of burned monasteries, may subsequently have passed from one bric-à-brac shop to another, where they have been piled up to be pulled about at each new inspection, and literally trodden under foot, whereby they have finally been reduced to a state of colorless, grayish, or black rags. Still such pictures may not unfrequently be awakened, as it were, to new life, to their original brilliancy of color, if, with all necessary care, their injured limbs are put together again, their wounds are healed, and fresh nourishment, air, and thorough cleansing, are administered to their lacerated bodies.

A sound constitution is, of course, a necessary condition for obtaining any such result; without it we can only obtain a partial cure. We see this with reference to the Bologna school of the seventeenth century. The pictures which you see here are instances of this. From the state of rags to which they were reduced they have passed, by appropriate treatment, into the state of firm, even well-conditioned, and clean pictures. The constitutional alteration characteristic of their time and school, however, could not be cured. You will, therefore, perceive that the contrast is too great between light and shade, that the half tones are too weak, and that the glazings spread on dark ground, which certainly existed formerly, have been destroyed by the growing of bolus and umber of the priming. That this is not the fault of the method of restoration is clearly proved by the state in which you will find all the pictures of this school, even those best preserved in the best galleries of all countries.

The constitutional diseases of pictures belonging to the French and to the English school of the last hundred years are of still more serious nature and much more difficult to cure. Many of them, though they were never exposed to any injury whatever, nor are likely ever to be so in our present state of civilization, cannot be guarded from premature decay in spite of all possible care with which they are kept.

The principal symptoms of their bad constitution are:

1. Darkening of the opaque bright colors.
2. Fading of the transparent brilliant colors.
3. Darkening, and above all, cracking of the transparent dark colors.

The best opportunity to study these several appearances is given us in the Museum of the Louvre, which contains a great number of such pictures in the section occupied by the French school. I have paid particular attention to the cracks in these pictures, as I find that in shape, in size, in position, as well as in relation to the various colors, they differ distinctly from the cracks in older pictures and in those of other schools. This, of course, is of importance, not only for the explanation of the reasons which produced them, but as a symptom which, in a given case, might determine the diagnosis, whether a picture be an original or only a copy. The special characteristics of these cracks are the following:

They are all but exclusively found in the thickly laid on transparent dark colors, and they are the deeper and the more gaping in proportion to the thickness of the layer of color and the extent of the dark surface. The chief cracks run parallel to the outlines of surfaces painted with bright opaque colors, such, for instance, as are used for the flesh tints, and which are more or less thickly laid on. But there is generally a slight distance between the bright colors and the cracks.

Lateral branches of these cracks pass into the white, but they do not gape, provided the white colors had been laid on directly upon the priming, and not upon a layer of dark transparent and not sufficiently dried color.

This examination of the cracks of pictures has sometimes afforded me a peculiar insight into the practice used for the picture. In the well known picture, for instance, by Géricault, of "The Wreck of the Medusa," in the Gallery of the Louvre, the cracks follow exactly the outlines of the bright flesh tints. The arm of one of the dead bodies hanging in the water is so covered by planks and water that nothing of the forearm is to be seen. It is, however, very easy to prove that originally that arm was painted in all its length, for the cracks do not only follow the outline of the visible upper arm, but also the no longer visible forearm and all the five fingers. This proves that the fore-part of the arm and the hand were originally painted in flesh tints before they were covered over by the planks and the water painted afterward. In Ingres' portrait of Cherubini, the face of the latter is beautifully preserved, while that of the Muse, as well as her drapery, is covered with cracks. In the depth of the cracks of the white drapery an intense blue tint is to be seen. Mr. Henri Lehmann, of Paris, the favorite pupil of Ingres, who knows the history of this picture as an eye-witness, and whom I consulted about this very striking appearance, gave me the following information: Ingres painted the head of Cherubini in Paris, and then took it with him to Rome. There it was pieced into a new canvas and lined. Then the Muse was painted, and before the colors were perfectly dry, another model was chosen, and a new Muse painted over the old one. The color of the drapery was likewise altered, and this explains the cracks in the white color, and explains also why the blue appears in the depth of the cracks of the drapery.

Among the English artists of the last hundred years, some have painted with the same material and by the same process as their French contemporaries, and consequently with the same unfortunate results. Others avoided these by using the same material with more precautions. Others, again, and among them Sir Joshua Reynolds, have in their different works followed various practices, and consequently had varied results. Thus some of Sir Joshua's pictures have kept perfectly sound. Others are cracked in the characteristic way just mentioned. Others, again, are cracked in an absolutely irregular way. We can easily form an idea of it, if we read in his "Diary Notes," for instance, the way in which he painted the portrait of Miss Kirkman, which he began with whiting and gum tragacanth, then covered it successively with wax, then white of eggs, and then varnished it.

The study of the alterations already fully developed in pictures painted within the last hundred years only, and their comparison with the works of the old masters, would suggest the following rules for the process of painting:

1. The oil should in all colors be reduced to a minimum, and under no form should more of it than absolutely necessary be introduced into a picture.

2. All transparent colors, which dry very slowly, should be ground not with oil at all, but with a resinous vehicle.

3. No color should be put on any part of a picture which is not yet perfectly dry; and, above all, never a quick drying color upon a slowly drying one, which is not yet perfectly dry.

4. White and other quick drying opaque colors may be put on thickly. On the contrary, transparent and slowly drying colors should always be put on in thin layers.

If the effect of a thick layer of these latter is required, it must be produced by laying one thin layer over another, taking care to have one completely dry before the next is laid on. If transparent colors are mixed with sufficient quantity of white lead, they may be treated like opaque ones.

We come now to the last layer of the picture, to that one which is spread over its surface in order to equalize optical irregularities, and to protect it at the same time from the air. I mean the varnish.

The varnish may crack or get dim, then it should be treated by Pettenkofer's method; but it may become dark yellow, brown and dirty, and so hide the picture that it becomes necessary to take it off and replace it by a thin layer of new varnish. It is here that picture restorers, or we may say picture cleaners, display their beneficial skill, and also their very destructive activity.

If a picture is throughout painted in oil, if its substance has remained sound and even, and varnished with an easily soluble mastic or dammar varnish, then there will be neither difficulty nor danger in removing the varnish. This can, in such a case, be done either by a dry process, that is, by rubbing the surface with the tips of the fingers, and thus reducing the varnish by degrees to a fine dust, or by dissolving the varnish by application of liquids, which, when brought only for a short time into contact with the oil painting, will not endanger it. We have, however, seen that the works of the old masters are not painted with oil colors like those used by modern painters, but, on the contrary, that certain pigments, and especially the transparent colors used for glazing, were ground only with resinous substances. These latter have, in the course of time, been so thoroughly united with the layer of varnish spread over the surface of the picture, that there no longer exists any decided limit between the picture and the varnish. It is in such pictures that a great amount of experience, and knowledge of the process used for the picture, as well as precaution, are required in order to take away from the varnish as much only as is indispensable, and without interfering with the picture itself. Numberless works of art have been irreparably injured by restorers, who, in their eagerness to remove dirt and varnish, attacked the painting itself. They then destroyed just that last finishing touch of the painting, without which it is no longer a masterpiece.

The difficulty and danger are much greater in cleaning those pictures which have not been varnished with the ordinary easily dissolved mastic or dammar varnish, but have been painted over with oil, oil varnish, or oleo-resinous varnish. It seems incredible that these substances should ever be used for such purposes; it is, however, a fact that there are still people who fancy that it will contribute to the good preservation of their pictures to brush from time to time a little of those liquids over their surface. They recognize too late that the varnish becomes more and more dark, of a brownish color, and opaque. If such varnish has afterward to be removed, then we meet with the great difficulty, that this can be done only with substances which would just as easily dissolve the whole picture as the hardened layers spread over it.

This shows what can be the value of those universal remedies which from time to time appear, and are praised for the innocuous way in which pictures by their means may be cleaned.

There is at this moment a great discussion going on in Italy about Luporini's method. Luporini is a painter and picture restorer in Pisa, who believes himself to have invented a new means of cleaning pictures without any danger. Some months ago, in Florence, I examined a large number of pictures cleaned by him. Those of the Gallery of St. Donato, belonging to Prince Demidoff, mostly Flemish and Dutch landscapes, are cleaned very well and without any injury to the painting. On the contrary, the St. John, by Andrea del Sarto, one of the finest pictures of the Palazzo Pitti, I found very much altered by the restoration of Luporini. I had studied that picture very closely the year before, and should now sooner believe it to be a modern copy than the cleaned original. It has lost all softness of outline and the characteristic expression of the face. The change in the flesh tints can scarcely be explained otherwise but by an entire removal of the glazing.

I think it is taking a heavy responsibility to allow a new experiment to be tried upon such an invaluable work of art. Even private persons, who are fortunate enough to be in possession of such treasures, ought to feel responsible for the good preservation of masterpieces, which are, it is true, their material property, but which intellectually belong to the whole civilized world of the present and of the future.

DRY PLATE PROCESS OF M. ANDRIEUX.

IN the *Moniteur de la Photographie* appear the details of a dry plate process, given by M. Maurice Andrieux. They are as follows:

"After the glass plates have been covered with gelatine by plunging them into a solution of white gelatine, made up of water 1,000 parts and gelatine 2 parts, they are dried.

"The collodion is prepared with—

Ether	300 cub. cents.
Alcohol at 40°	75 "
Pyroxyline	4 grammes.

Of this pyroxyline, two grammes should be of pulverulent cotton, which is of a porous character, and two grammes of a resistant cotton, which adheres more tenaciously to the glass plate. To 100 cubic centimeters of this normal collodion, fifteen to twenty-five of the under-mentioned iodizing solution is added:

Alcohol at 40°	100 cub. cents.
Iodide of cadmium	8 grammes.
Bromide of cadmium	6 "

"The collodion is very transparent. The silver bath employed should be of eight per cent. strength, and slightly acid; the plate is permitted to remain in the bath for three to five minutes, until all appearance of greasiness has disappeared.

"After carefully washing in water, the film is covered four or five times with tannin, or better still is it to employ two vessels with the tannin solution, the first, so to speak, to remove the water adhering to the plate, and the second of full strength. The tannin solution is composed of—

Tannin	3 grammes.
Filtered water	100 cub. cents.
Gum arabic	1 gramme.

"The plate is allowed to dry completely before it is used, being stood to drain upon filter paper. Put away in a plate box (in the dark), they are ready for use at any time.

"The period of exposure varies from fifteen seconds in the sun to forty-five seconds in the shade, with an apparatus for landscapes of 20 centimeters focal length, and a diaphragm of 12 millimeters.

"To develop, you prepare the under-mentioned solution.

"Transparent sesquicarbonate of ammonia; that is to say, it must not be used as usually met with—in an opaque condition. If only the latter is to be had, the outside is scraped off, and the inner transparent part only employed. Of this salt a saturated solution is made, and to every 100 grammes of solution are added 10 grammes of alum. This constitutes No. 1 solution.

"No. 2 consists of—

Alcohol at 40°	100 cub. cents.
Pyrogallic acid	10 grammes.

"No. 3—

Filtered water	100 cub. cents.
Bromide of potassium	2 grammes.

"To develop one's plate, there is taken filtered or rain-water 100 cubic centimeters, to which is added 2 cubic centimeters of solution No. 1; further, 4 drops of solution No. 2, and, again, 4 drops of solution No. 3.

"After mixing, the solution is poured upon the plate, placed in a porcelain dish, where the image should appear after ten to forty seconds.

"When all the details have appeared, but faintly, the plate is gently washed and put into another dish. This is better than holding the plate in the hand.

"Upon it is poured 100 cubic centimeters of distilled water, into which has been put just previously 20 cubic centimeters of the under-mentioned solution:

Water	300 cub. cents.
Glacial acetic acid	20 "
Pyrogallic acid	2 grammes.

"Into the solution is also put 2 cubic centimeters of a three per cent. solution of nitrate of silver; in this way a sufficient degree of intensity is obtained, the solution being replaced again and again if very opaque films are wanted.

"The fixing is done with hyposulphite of soda and the plates finally well washed."